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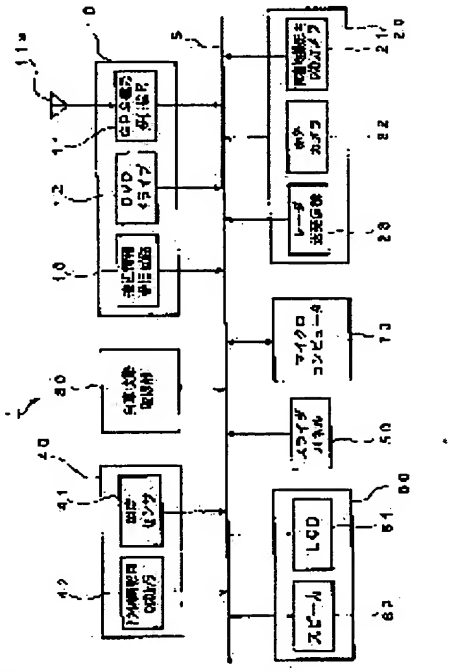
(54) ENVIRONMENTAL COMPLEXITY ARITHMETIC SYSTEM, ENVIRONMENTAL RECOGNITION LEVEL ESTIMATION SYSTEM AND OBSTRUCTION WARNING SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To support obstruction recognition efficiently and accurately without presenting a driver with excessive information.
SOLUTION: A microcomputer 70 divides a pickup image produced by an obstruction imaging CCD camera 21 into regions A to D, and computes complexity C of traffic environment in each of the regions B to D according to the following expression: $C=a.C1+\beta.C2+\gamma.C1.C2$, where the index C1 represents a total number of brightness-divided blocks, the index C2 represents a total number of red-system-divided blocks, and a, β and γ are weight coefficients of respective given values.



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CLAIMS

[Claim(s)]
[Claim 1] The environmental complexity arithmetic unit equipped with a complexity operation means to calculate environmental complexity, at least based on one side of distribution of change of the brightness contained in the image pick-up image generated with an image pick-up means to generate an image pick-up image based on the image pick-up light from an environment, and said image pick-up means, and distribution of the red system pixel contained in said image pick-up image.
[Claim 2] Until said complexity operation means sets a brightness division block as the image pick-up image generated with said image pick-up means and is judged that the brightness value of each pixel is homogeneous in the set-up brightness division block The environmental complexity arithmetic unit according to claim 1 characterized by calculating environmental complexity based on the number of the brightness division blocks with which it repeated dividing said brightness division block and setting up a new brightness division block, and the brightness value of each pixel became homogeneity to said image pick-up image.
[Claim 3] Said complexity operation means until it sets a red system division block as the image pick-up image generated with said image pick-up means and the set-up red system division block consists of only predetermined red system pixels Repeat dividing said red system division block and setting up a new red system division block, and said image pick-up image is received. The environmental complexity arithmetic unit according to claim 1 characterized by calculating environmental complexity based on the number of the red system division blocks which consist of only said predetermined red system pixels.
[Claim 4] Until said complexity operation means sets a brightness division block as the image pick-up image generated with said image pick-up means and is judged that the brightness value of each pixel is homogeneous in the set-up brightness division block Repeat dividing said brightness division block and setting up a new brightness division block, and said image pick-up image is received. Until it calculates the number of the brightness division blocks with which the brightness value of each pixel became homogeneity, it sets a red system division block as the image pick-up image generated with said image pick-up means and the set-up red system division block consists of only predetermined red system pixels Repeat dividing said red system division block and setting up a new red system division block, and said image pick-up image is received. The environmental complexity arithmetic unit according to claim 1 characterized by calculating the number of the red system division blocks which consist of only said predetermined red system pixels, and calculating environmental complexity based on the number of said brightness division blocks, and the number of red system division blocks.

[Claim 5] Environmental recognition degree presumption equipment equipped with an environmental recognition degree presumption means to presume an environmental recognition degree based on the complexity calculated with the complexity arithmetic unit and said complexity arithmetic unit of four given in any 1 term from claim 1.
[Claim 6] It is environmental recognition degree presumption equipment according to claim 5 characterized by presuming that the environmental recognition degree of said environmental recognition degree presumption means is low when the complexity calculated with said complexity arithmetic unit is beyond a threshold, and presuming that an environmental recognition degree is high when the complexity calculated with said complexity arithmetic unit is smaller than a threshold.
[Claim 7] It is environmental recognition degree presumption equipment according to claim 5 or 6 which is further equipped with an illuminance detection means to detect an environmental illuminance, and said environmental recognition degree presumption means sets up said threshold corresponding to the illuminance detected by said illuminance detection means, and is characterized by presuming an environmental recognition degree using the set-up threshold.
[Claim 8] It has further a posture change detection means to detect posture change of an observer. Said environmental recognition degree presumption means A threshold is greatly set up as posture change of an observer detected with said posture change detection means becomes large. Environmental recognition degree presumption equipment of seven given in any 1 term from claim 5 which sets up a threshold small and is characterized by presuming an environmental recognition degree using the set-up threshold as posture change

of an observer detected with said posture change detection means becomes small.
[Claim 9] The obstruction alarm equipped with an alarm means perform the alarm about said obstruction when a predetermined field including the location of the obstruction detected with an obstruction location detection means detect the environmental recognition degree presumption equipment of eight given in any 1 term and the location of an obstruction from claim 5 which presumes an environmental recognition degree for every predetermined field, and said obstruction detection means is presumed that an environmental recognition degree is low by said environmental recognition degree presumption means.
[Claim 10] Said environmental recognition degree presumption equipment divides the field except the lower part of an image pick-up image into two or more presumed fields, and an environmental recognition degree is presumed for every divided presumption field. Said alarm means When the location of the obstruction detected by said obstruction location detection means is in any of said presumed field and the recognition degree of the environment of the presumed field concerned is presumed to be low by said environmental recognition degree presumption means The obstruction alarm according to claim 9 characterized by performing the alarm about the obstruction which exists in the high presumed field of a priority.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an environmental complexity arithmetic unit, environmental recognition degree presumption equipment, and an obstruction alarm, and relates to the environmental complexity arithmetic unit, the environmental recognition degree presumption equipment, and the obstruction alarm which offer obstruction recognition exchange of a driver especially according to the traffic environment of the perimeter of a car.
[0002]
[Description of the Prior Art] In operation of a car, it is important to check elutriation from right and left in the time of rectilinear propagation of a car or to check a crossing object on either side to a travelling direction in the time of the right and left chip box of a car, when preventing accident. The mobile which jumps out of right and left, or is crossed can consider various things, such as a pedestrian, a two-flower vehicle, and a four-flower vehicle.
[0003] In JP,3-260813,A, the environmental recognition equipment which detects such a mobile is proposed. Environmental recognition equipment acquired profile information by extracting the difference and the closed interval field of lightness information, and recognizes the migration body from profile information. However, since the lighting conditions which surround a car change every moment and have the influence of disturbance light etc., it is rare to be able to extract a profile completely vividly. Therefore, since the above-mentioned environmental recognition equipment performs image recognition only using profile information, its correspondence to an environmental variation from the little of amount of information is weak. In the case where it is carried in a car and an obstruction etc. is detected especially, since it is influenced [which was mentioned above] greatly, it is hard to say that a mobile is detectable the optimal. Moreover, since the lightness which was easy to be influenced of a shadow, disturbance light, etc., and changed with disturbance light affects change of a center of gravity or area directly, the processing which extracts a direct closed interval from lightness information is difficult.
[0004] In addition, the detection technique which added internal information to profile information, such as template matching and texture matching, is also proposed. However, the processing time starts or there is a problem of taking the time and effort which prepares the huge information about a template beforehand.
[0005] Under such a background, it is derived from the technique which compresses image information, and the technique of catching the image pick-up information on a camera with distribution of lightness data is proposed in recent years.
[0006] In JP,11-142168,A, principal component analysis which is one of the multivariate analyses is performed, image pick-up information is mapped in the information space stretched with normalization principal component characteristic quantity, and the technique which improved the technique of carrying out image recognition is proposed by analyzing the behavior of the data in information space. This technique performs more robust environmental recognition for normalization principal component characteristic quantity using car movement information and actuation information. Moreover, in JP,2000-19259,A, the technique of recognizing a body using visible-ray image information and infrared image information other than the light is proposed.
[0007] However, these techniques are difficult to recognize a mobile, when many factors which bar recognition of bodies, such as a guard rail and a halt vehicle, exist. For example, there is a problem which cannot recognize the pedestrian in the foot walks or crossings other than on [through which a car passes] a road surface, and the pedestrian who has run out of between the standby location of a bicycle or a halt vehicle.
[0008] On the other hand, for example by JP,11-301343,A, the lighting system for cars which used not only the obstruction itself but the camera (light, infrared rays) and which predicts the appearance rate of a migration obstruction according to environmental (road configuration) recognition is proposed. Moreover, in JP,11-232569,A, the pedestrian alarm system with the equipment which sends to a vehicle side whether the pedestrian approached the crossing etc. is proposed. Furthermore, in JP,6-144129,A, the nudge assistant equipment which aims at a nudge by choosing at random one cautions item by which two or more preparation was carried out to

the same condition of being careful, and reporting to a driver is proposed, without recognizing a migration obstruction positively.
[0009] Thus, the migration obstruction recognition exchange which offers obstruction recognition exchange to a driver is proposed by performing approach warning of the thing in consideration of the automatic recognition of a migration obstruction, and the appearance probability of a migration body, or a pedestrian etc.
[0010] However, finally the driver itself recognizes a migration obstruction. If the vision cognition of the driver and a cognitive property were not taken into consideration, since a lot of information was shown to the driver too much, a driver may be confused on the contrary. Moreover, although there are few amounts of information presentation, they are inefficient. [of the approach of uniting a cautions item with a location and showing it at random]
[0011] This invention is proposed in order to solve the technical problem mentioned above, and it aims at offering the environmental complexity arithmetic unit, the environmental recognition degree presumption equipment, and the obstruction alarm which can offer obstruction recognition exchange efficiently and exactly, without showing a driver superfluous information.
[0012]
[Means for Solving the Problem] Invention according to claim 1 is equipped with a complexity operation means to calculate environmental complexity, at least based on one side of distribution of change of the brightness contained in the image pick-up image generated with an image pick-up means to generate an image pick-up image based on the image pick-up light from an environment, and said image pick-up means, and distribution of the red system pixel contained in said image pick-up image.
[0013] As for an image pick-up means, in invention according to claim 1, it is desirable to be installed so that a front traffic environment may be picturized for example, from a car front seat. A complexity operation means can ask for the spatial frequency which shows the complexity of an image from distribution of brightness change included in an image pick-up image. Moreover, a complexity operation means can ask for the complexity of an image from distribution of the red system pixel contained in an image pick-up image.
[0014] Invention according to claim 2 is set to invention according to claim 1. Said complexity operation means Until it sets a brightness division block as the image pick-up image generated with said image pick-up means and it is judged in the set-up brightness division block that the brightness value of each pixel is homogeneous It repeats dividing said brightness division block and setting up a new brightness division block, and is characterized by calculating environmental complexity to said image pick-up image based on the number of the brightness division blocks with which the brightness value of each pixel became homogeneity.
[0015] In invention according to claim 2, a complexity operation means sets up a brightness division block to an image pick-up image. The brightness division block set up first shows the field which calculates complexity. And said brightness division block is divided, the divided brightness division block is set up as a new brightness division block, and this processing is repeated until it is judged in a brightness division block that the brightness value of each pixel is homogeneous. Here, the difference of the maximum of not only when the brightness value of each pixel is in agreement in the brightness value of each pixel being homogeneous, but a brightness value and the minimum value of a brightness value should just be below a predetermined value. Namely, dispersion in the brightness value of each pixel has just become below a predetermined value.
[0016] And if it is judged that the brightness value of each pixel in all brightness division fields is homogeneous, it will ask for the number of these the brightness division blocks of all as environmental complexity. The number of such brightness division blocks supports spatial frequency. That is, if there are many totals, there are many high frequency components and an image pick-up image is complicated. Moreover, if there are few totals, there are few high frequency components and the image pick-up image is simple. Thus, it can ask for environmental complexity by asking for the number of brightness division blocks.
[0017] Invention according to claim 3 is set to invention according to claim 1. Said complexity operation means Until it sets a red system division block as the image pick-up image generated with said image pick-up means and the set-up red system division block consists of only predetermined red system pixels It repeats dividing said red system division block and setting up a new red system division block, and is characterized by calculating environmental complexity to said image pick-up image based on the number of the red system division blocks which consist of only said predetermined red system pixels.
[0018] In invention according to claim 3, a complexity operation means sets up a red system division block to an image pick-up image. The red system division block set up first shows the field which calculates complexity. The red system division block concerned is divided until a red system division block consists of only predetermined red system pixels. And the divided red system division block is set up as a new red system division block, and this processing is repeated. If all red system division blocks consist of only predetermined red system pixels, it will ask for the number of these the red system division blocks of all as environmental complexity. Red is compared green, and has the property that eye attractiveness is high, and, as for the number of red system division blocks, the complexity of an image is shown. Therefore, it can ask for environmental complexity by

calculating the number of the above-mentioned red system division blocks.
[0019] Invention according to claim 4 is set to invention according to claim 1. Said complexity operation means Until it sets a brightness division block as the image pick-up image generated with said image pick-up means and it is judged in the set-up brightness division block that the brightness value of each pixel is homogeneous Repeat dividing said brightness division block and setting up a new brightness division block, and said image pick-up image is received. Until it calculates the number of the brightness division blocks with which the brightness value of each pixel became homogeneity, it sets a red system division block as the image pick-up image generated with said image pick-up means and the set-up red system division block consists of only predetermined red system pixels Repeat dividing said red system division block and setting up a new red system division block, and said image pick-up image is received. It is characterized by calculating the number of the red system division blocks which consist of only said predetermined red system pixels, and calculating environmental complexity based on the number of said brightness division blocks, and the number of red system division blocks.

[0020] In invention according to claim 4, a complexity operation means asks for the number of brightness division blocks like invention according to claim 2, asks for the number of red system division blocks like invention according to claim 3 further, and asks for environmental complexity based on these totals. It is desirable to square a respectively predetermined weighting multiplier to the product of the number of brightness division blocks, the number of red system division blocks, the number of brightness division blocks, and the number of red system division blocks, and to ask for these total as environmental complexity, at it.
[0021] Invention according to claim 5 is equipped with an environmental recognition degree presumption means to presume an environmental recognition degree based on the complexity calculated with the complexity arithmetic unit and said complexity arithmetic unit of four given in any 1 term from claim 1.
[0022] In invention according to claim 5, since the complexity of an environmental image pick-up image is shown, the complexity calculated with the complexity arithmetic unit is used as a parameter for presuming the recognition degree of an observer's environment. That is, an environmental recognition degree presumption means can presume an environmental recognition degree based on the above-mentioned complexity.
[0023] It is characterized by presuming that the environmental recognition degree of invention according to claim 6 is low in invention according to claim 5 when the complexity which calculated said environmental recognition degree presumption means with said complexity arithmetic unit is beyond a threshold, and presuming that an environmental recognition degree is high when the complexity calculated with said complexity arithmetic unit is smaller than a threshold.
[0024] In invention according to claim 6, the threshold used as the reference value of an environmental recognition degree is set up. That is, a threshold is a value of the complexity which shows simple middle that an environment is complicated. Then, it presumes that the environmental recognition degree of an environmental recognition degree presumption means is low when complexity is beyond a threshold in using this threshold, and when complexity is smaller than a threshold, it can be presumed that an environmental recognition degree is high.
[0025] It is characterized by equipping invention according to claim 7 with an illuminance detection means to detect an environmental illuminance, further in invention according to claim 5 or 6, and for said environmental recognition degree presumption means setting up said threshold corresponding to the illuminance detected by said illuminance detection means, and presuming an environmental recognition degree using the set-up threshold.
[0026] In invention according to claim 7, even if complexity is fixed, when it is bright in the car exterior or it becomes dark, an observer may sense that an environment is complicated or may sense that it is simple. Then, in order to amend change of the recognition degree of the environment by change of such an illuminance, it is desirable to use the threshold table on which the threshold corresponding to an illuminance was described beforehand. Thereby, if an illuminance is detected by the illuminance detection means, the threshold corresponding to the detected illuminance can be set up. And an environmental recognition degree can be presumed using the set-up threshold. Consequently, no matter an illuminance may be what value, an environmental recognition degree can be presumed correctly.
[0027] Invention according to claim 8 is further equipped with a posture change detection means to detect posture change of an observer in invention of seven given in any 1 term from claim 5. Said environmental recognition degree presumption means It is characterized by presuming an environmental recognition degree using the threshold which set up the threshold greatly as posture change of an observer detected with said posture change detection means became large, set up the threshold small and was set up as posture change of an observer detected with said posture change detection means became small.
[0028] In invention according to claim 8, an observer has the degree which recognizes an environment in a high inclination, when posture change is large. By setting up a threshold greatly as posture change of an observer becomes large, and setting up a threshold small as posture change of an observer becomes small, an

environmental recognition degree presumption means can presume an environmental recognition degree correctly so that it may agree in an observer's actual vision property.
[0029] The environmental recognition degree presumption equipment of eight given in any 1 term from claim 5 invention according to claim 9 presumes an environmental recognition degree to be for every predetermined field; When a predetermined field including the location of the obstruction detected with an obstruction location detection means to detect the location of an obstruction, and said obstruction detection means is presumed that an environmental recognition degree is low by said environmental recognition degree presumption means, it has an alarm means to perform the alarm about said obstruction.
[0030] In invention according to claim 9, an obstruction location detection means detects the location of an obstruction. At this time, environmental recognition degree presumption equipment presumes the recognition degree of the environment of a predetermined field including the location where the obstruction was detected. Here, when an environmental recognition degree is high, an observer can recognize enough the obstruction detected by the obstruction location detection means. On the other hand, when an environmental recognition degree is low, an observer may be unable to recognize the obstruction detected by the obstruction location detection means. Then, an alarm means performs the alarm about an obstruction, when it is presumed that the environmental recognition degree of a predetermined field including the location of an obstruction is low. Thereby, even when an obstruction is in the field where an environmental recognition degree is low, an observer can recognize in advance that there is an obstruction and can avoid accident. In addition, when it is presumed that the environmental recognition degree of the predetermined [an observer can be made to call attention when an alarm means outputs an image or voice] field in which an alarm means includes the location of an obstruction again is high, the alarm about an obstruction is not performed. Thereby, in the case where an obstruction is in the field where an environmental recognition degree is high, since an observer can recognize the obstruction, he does not receive troublesomeness with an excessive alarm.
[0031] Invention according to claim 10 is set to invention according to claim 9. Said environmental recognition degree presumption equipment The field except the lower part of an image pick-up image is divided into two or more presumed fields, and an environmental recognition degree is presumed for every divided presumption field. Said alarm means When the location of the obstruction detected by said obstruction location detection means is in any of said presumed field and the recognition degree of the environment of the presumed field concerned is presumed to be low by said environmental recognition degree presumption means It is characterized by performing the alarm about the obstruction which exists in the high presumed field of a priority.
[0032] In invention according to claim 10, environmental recognition degree presumption equipment divides the field except the lower part of an image pick-up image into two or more presumed fields, and presumes an environmental recognition degree for every divided presumption field. That is, an environmental recognition degree is not presumed about the lower part of an image pick-up image. The lower part of an image pick-up screen shows the image of the environment in front of an observer, and the reason is that there is no semantics which presumes the degree of recognition of the environment.
[0033] It judges whether an alarm means has the location of the obstruction detected by said obstruction location detection means in any of said presumed field, and the recognition degree of the environment of the presumed field concerned was presumed to be low by said environmental recognition degree presumption means. Here, an obstruction is detected and an environmental recognition degree chooses all low presumption fields. And the alarm of a purport with which an obstruction exists is performed about the high presumed field of a priority among the selected appointed fields. While big accident is avoidable by making an observer careful of the thereby most dangerous field, about the field which is not not much dangerous, it can prevent an observer becoming a surfeit of information and getting confused by not reporting to an observer.
[0034]
[Embodiment of the Invention] It explains to a detail, referring to a drawing about the gestalt of desirable operation of this invention hereafter.
[0035] The gestalt of operation of the 1st of [gestalt of the 1st operation] this invention is applicable to the obstruction alarm 1 of a configuration of being shown in drawing 1 . The obstruction alarm 1 the infrastructure information which detects infrastructure information from the infrastructure of the car exterior The infrastructure information detecting element 10, The obstruction information detecting element 20 which detects a road and the information about the obstruction of the circumference of it, The self-vehicle condition detecting element 30 which detects the operating state of a self-car, and the environmental-information detecting element 40 which detects the environment of a driver or the car exterior, It has the slider panel 50 for inputting the vision property which shows the degree of environmental recognition of a driver, the obstruction information output section 60 which outputs obstruction information, and the microcomputer 70 which controls the whole based on the information detected in each part.
[0036] The infrastructure information detecting element 10 is equipped with the GPS receiving circuit 11 which receives a GPS (Global PositioningSystem) signal, the DVD drive 12 which reads the map information currently

recorded on the DVD disk, and the approach information receiving circuit 13 which receives approach information.
[0037] The GPS receiving circuit 11 receives the GPS signal which has the positional information of time of day and a GPS Satellite through GPS antenna 11a, and supplies it to a microcomputer 70 through a data bus 5. Based on the positional information which is carrying out current transit, a car reads map information from a DVD disk, and supplies the DVD drive 12 to a microcomputer 70 through a data bus 5. The approach information receiving circuit 13 receives the approach information transmitted from the data carrier reader mentioned later, and supplies it to a microcomputer 70 through a data bus 5.
[0038] The obstruction information detecting element 20 is equipped with CCD camera 21 for obstruction photography for photoing the obstruction of a path on the street or the perimeter of a road, the infrared camera 22 for photoing the obstruction of a path on the street or the perimeter of a road with infrared radiation, and the radar transceiver 23 for recognizing a forward cardiac failure theory object.
[0039] CCD camera 21 for obstruction photography and the infrared camera 22 are installed so that the body of the direction of the car front can be picturized. And CCD camera 21 for obstruction photography and the infrared camera 22 supply the photoed photography image to a microcomputer 70 through a data bus 5. A radar transceiver 23 receives the optical radar reflected by the obstruction while extracting a pulse-like optical radar keenly to the obstruction concerned and transmitting in the two-dimensional direction, in order to recognize a forward cardiac failure theory object. in addition, a radar transceiver 23 may be a thing which does not restrict, but transmits and receives an electric-wave radar and which transmits and receives an optical radar.
[0040] The self-vehicle condition detecting element 30 is equipped with for example, a wheel speed sensor, a steering angle sensor, a throttle-valve sensor, the master cylinder oil pressure sensor, the yaw rate sensor, the order acceleration sensor, the lateral acceleration sensor, etc. And the self-vehicle condition detecting element 30 detects the vehicle speed, a handle steering include angle, an accelerator control input, the amount of brakes operation, a yaw rate, a roll rate, a pitch rate, order acceleration, lateral acceleration, and a winker control input, and supplies them to a microcomputer 70.
[0041] The environmental-information detecting element 40 is equipped with the illuminance sensor 41 which detects the illuminance of the car exterior, and CCD camera 42 for driver photography which photos a driver. Here, although only one CCD camera 42 for driver photography is formed, three CCD cameras which picturize the method of forward presence of a driver, the method of the forward right, and the method of the forward left, respectively may be formed so that posture change of a driver can be detected easily.
[0042] The slider panel 50 is for carrying out the actuation input of the vision property which shows the complexity of an external environment according to the subjectivity of a driver. As shown in the slider panel 50 and drawing 2 , it has the movable slider 51 right and left. A driver operates a slider 51 in the direction of "weakness", when he tends to overlook the traffic environment (i.e., when judging that it is hard to recognize the traffic environment of the car exterior). Moreover, a driver operates a slider 51 in the direction of "a little more than", when a traffic environment can be seen well (i.e., when it is easy to recognize the traffic environment of the car exterior). Although this mentions later in detail, a microcomputer 70 can presume an environmental recognition degree in consideration of the present vision property of a driver.
[0043] The obstruction information output section 60 is equipped with LCD (Liquid Crystal Display)61 which outputs obstruction information with an image, and the loudspeaker 62 which outputs obstruction information with voice.
[0044] The microcomputer 70 is constituted by CPU (Central Processing Unit) which is not illustrated, RAM (Random Access Memory) which is the work area of data, and ROM (Read Only Memory) the program and appearance range presumption table which perform various kinds of routine processings mentioned later, and the threshold table are remembered to be. A microcomputer 70 presumes an obstruction with appearance possibility based on the information from each part, presumes the environmental recognition degree of a driver, or performs the alarm of obstruction information.
[0045] (Main routine) In the obstruction alarm 1 constituted as mentioned above, a microcomputer 70 performs processing from the step ST 1 shown in drawing 3 to a step ST 3. Here, processing from a step ST 1 to a step ST 3 is explained briefly first, and the concrete subroutine of each processing is explained after that.
[0046] A microcomputer 70 presumes the obstruction which may appear in the travelling direction of a self-vehicle while detecting a self-vehicle location based on the information detected by the infrastructure information detecting element 10 (step ST 1). And the environmental recognition degree which shows whether the image pick-up image of the environment of the travelling direction of a self-vehicle is divided, and it is easy to recognize a driver for every divided field is presumed (step ST 2). Finally, a microcomputer 70 performs the alarm about an obstruction to a driver if needed based on obstruction information with appearance possibility, and the environmental recognition degree for every predetermined field with an image or voice (step ST 3).
[0047] ((ST) Step 1) At a step ST 1, a microcomputer 70 performs processing from the step ST 11 specifically shown in drawing 4 to a step ST 14 that the obstruction which may appear in the travelling direction of a self-

vehicle should be presumed.
[0048] At a step ST 11, a microcomputer 70 is the circumference of a self-vehicle location, and detects the migration obstruction outside the field-of-view range of a driver while it detects the location of a self-vehicle. In addition, an infrastructure which is explained below, for example is used here.
[0049] For example, as shown in drawing 5 , the pedestrian is always carrying the goods (for example, cellular phone) with which the data carrier 16 was formed. Moreover, the data carrier 16 is formed in the two-flower vehicle or the four-flower vehicle. A data carrier 16 can output some kinds of approach information, and the data carrier 16 of a pedestrian, a two-flower vehicle, and a four-flower vehicle outputs approach information different, respectively. On the other hand, the data carrier reader 17 which receives approach information is installed in the bad crossing and bad zebra zone of a prospect. If a data carrier 16 approaches, the data carrier reader 17 will receive approach information, and will transmit this approach information to the obstruction alarm 1.
[0050] If the approach information transmitted from the data carrier reader 17 is received in the approach information receiving circuit 13, the microcomputer 70 of the obstruction alarm 1 can pinpoint the location of an obstruction, and can recognize any of a pedestrian, a two-flower vehicle, and a four-flower vehicle the obstruction is further.
[0051] And a microcomputer 70 is the circumference of a self-vehicle location, detects the migration obstruction outside the field-of-view range of a driver, and recognizes the classification (a man, a two flower vehicle, or a four flower vehicle) of the migration obstruction concerned while it detects the location of a self-vehicle based on the GPS signal received by the GPS receiving circuit 11, the map information read from the DVD drive 12, and the approach information received by the approach information receiving circuit 13.
[0052] Furthermore, a microcomputer 70 presumes the range where a migration obstruction on the street [around a self-vehicle] may appear based on the classification of a migration obstruction with reference to the appearance range presumption table shown in drawing 6 R> 6. For example, when the four-flower vehicle has been recognized as a migration obstruction, the four-flower vehicle concerned presumes that a microcomputer 70 may appear in a travelling direction within the limits of 10m from a current location. Moreover, when the pedestrian has been recognized as a migration obstruction, the pedestrian concerned presumes that it may appear in within the limits with a radius of 1m from the current position.
[0053] A microcomputer 70 sets up the system of coordinates (henceforth "self-vehicle circumference system of coordinates") which consist of a shaft which intersects perpendicularly with the travelling direction shaft and travelling direction shaft of a self-vehicle, describes the appearance possibility range of a migration obstruction to self-vehicle circumference system of coordinates, and shifts to a step ST 12.
[0054] At a step ST 12, a microcomputer 70 detects the obstruction in field-of-view within the limits of a driver. Here, a microcomputer 70 makes CCD camera 21 for obstruction photography, and the infrared camera 22 drive, and acquires the image pick-up image generated with CCD camera 21 for obstruction photography, and the infrared camera 22. And a migration obstruction is detected by obtaining the image which fully attached contrast for human being who poses a problem especially on insurance, or a vehicle with the other thing by asking for the difference of the image generated with each camera.
[0055] Moreover, based on the both-way time amount of the optical radar from transmission by the radar transceiver 23 to reception, a microcomputer 70 obtains the depth map of the forward cardiac failure theory object of a self-vehicle, and recognizes a forward cardiac failure theory object. A microcomputer 70 describes the migration obstruction recognized by doing in this way to self-vehicle circumference system of coordinates, and shifts to a step ST 13.
[0056] At a step ST 13, a microcomputer 70 detects a self-vehicle condition based on the information from the self-vehicle condition detecting element 30. Here, a microcomputer 70 detects the vehicle speed, a handle steering include angle, an accelerator control input, the amount of brakes operation, a yaw rate, a roll rate, a pitch rate, order acceleration, lateral acceleration, and a winker control input, presumes the travelling direction of a self-vehicle, describes the presumed result of the travelling direction of a self-vehicle to self-vehicle circumference system of coordinates, and shifts to a step ST 14 as indicated by JP,11-301343,A, for example.
[0057] At a step ST 14, a microcomputer 70 leaves only the information on a migration obstruction that it may appear in advance prediction within the limits of a self-vehicle, to the self-vehicle circumference system of coordinates obtained by processing from a step ST 11 to a step ST 13, and removes the information on other. And if a microcomputer 70 is displayed on LCD61 by using as an obstruction display screen information about the migration obstruction described by self-vehicle circumference system of coordinates, it will shift to the step ST 2 which escaped from the subroutine and was shown in drawing 3 .
[0058] Here, the obstruction display screen shows the map of the perimeter the self-vehicle is running, the current position of a self-vehicle, the advance prediction range of a self-vehicle, and migration obstructions (people, vehicle, etc.) and the range of those which can be appeared, as shown in drawing 7 . The magnitude of the migration obstruction displayed on the obstruction display screen shows the range where the migration obstruction concerned may appear.

[0059] ((ST) Step 2) At a step ST 2, a microcomputer 70 performs processing from the step ST 21 specifically shown in drawing 8 to a step ST 24 that the degree a driver recognizes a perimeter [car] environment to be should be presumed.
[0060] At a step ST 21, a microcomputer 70 detects change of the posture of a driver using the information from the environmental-information detecting element 40. namely, the microcomputer 70 -- the image pick-up image from CCD camera 42 for driver photography -- inter-frame [every] -- difference -- asking -- the difference of an image pick-up image -- a value is detected as migration space quantity of a driver.
[0061] A microcomputer 70 counts "1", when migration space quantity is beyond a predetermined threshold, and when migration space quantity is smaller than a predetermined threshold, it does not count. And the counted value concerned is one or more thresholds TH, the counted value for the past 5 minutes is calculated, for example, when the counted value concerned is less than one threshold TH, it judges with posture change being "smallness", when it is under the threshold TH2 (> TH1), it judges with posture change being "inside", and when the counted value concerned is two or more thresholds TH, it judges with posture change being "size." Moreover, a microcomputer 70 acquires the illuminance of the car exterior detected by the illuminance sensor 41, and shifts to a step ST 22.
[0062] At a step ST 22, a microcomputer 70 calculates the environmental complexity C for every predetermined field of the obstruction display screen shown in drawing 7 . In addition, the complexity C said here means the parameter used in order to presume the recognition degree of the traffic environment of a driver.
[0063] First, a microcomputer 70 quadrisects the field which has an obstruction and its range which can be appeared among the obstruction display screens obtained at a step ST 1 in distance and a direction. Here, as shown in drawing 9 , the obstruction display screen is divided into Field A, Field B, Field C, and Field D. Thereby, the above-mentioned obstruction display screen adjoins Field A and Field A which are a field of the front transverse-plane short distance of a self-vehicle, adjoins Field B and Fields A and B which are fields of a front transverse-plane long distance of a self-vehicle, adjoins Field C and Fields A and B which are fields of a front left long distance of a self-vehicle, and has the field D which is a field of a front right long distance of a self-vehicle. In addition, from the obstruction display screen field A, typically, Field D is divided, as shown in drawing 10 .
[0064] Next, a microcomputer 70 calculates the complexity C of a traffic environment about each of Field B, Field C, and Field D based on the following formula (1).
[0065]
[Equation 1]

$$C = \alpha \cdot C1 + \beta \cdot C2 + \gamma \cdot C1C2 \qquad \cdots\cdots (1)$$

[0066] An index C1 shows the number of brightness division blocks, and the index C2 shows the number of red system division blocks. Moreover, alpha, beta, and gamma are weighting multipliers and take a predetermined value, respectively.
[0067] Here, the operation of an index C1 is explained. In addition, although a microcomputer 70 calculates an index C1 about Field B, Field C, and Field D as mentioned above, it explains calculating an index C1 using the image pick-up image shown in drawing 11 about Field B here.
[0068] A microcomputer 70 obtains an image pick-up image as made drive CCD camera 21 for obstruction photography, for example, shown in drawing 11 . And the whole image pick-up image concerned is set up as a brightness division block.
[0069] A microcomputer 70 calculates the difference of the maximum of the brightness value of each pixel, and the minimum value in the set-up brightness division block. A microcomputer 70 judges whether they are the maximum of a brightness value, and beyond a threshold predetermined in the difference of the minimum value, and when the above-mentioned difference is over the predetermined threshold, it divides a brightness division block into four. At this time, as for a microcomputer 70, it is desirable to divide a brightness division block so that it may consist of almost same numbers of pixels in every direction, and so that it may enlarge as much as possible.
[0070] When the brightness value of an image pick-up image shows drawing 12 (A), a microcomputer 70 calculates the difference of the maximum (180) of a brightness value, and the minimum value (000). And since it judged whether the difference (180) of the maximum of a brightness value and the minimum value was beyond a threshold (for example, 40) and the above-mentioned difference is over the threshold (40) here, as shown in drawing 12 (A), a brightness division block is divided into four.
[0071] A microcomputer 70 divides said brightness division block into four, and repeats setting up a new brightness division block until the difference of the maximum of the brightness value of each pixel and the minimum value becomes below a predetermined threshold in each divided brightness division block.
[0072] For example, the brightness division block BK1 shown in drawing 12 (A) consists of 4x4 pixels, and the minimum value of 180 and a brightness value of the maximum of a brightness value is 20. A microcomputer 70

searches for the difference (160) of the maximum of the brightness value of the brightness division block BK1, and the minimum value, and since the above-mentioned difference is beyond a threshold (40), as shown in drawing 12 (B), it divides the brightness division block BK1 into four (BK2, BK3, BK4, BK5).
[0073] And since the difference (39) of the maximum of the brightness value of the brightness division block BK2 and the minimum value is not beyond a threshold (40), a microcomputer 70 does not divide to the brightness division block BK2. On the other hand, about the brightness division blocks BK3, BK4, and BK5, since the difference of the maximum of a brightness value and the minimum value is beyond a threshold (40), as shown in drawing 1212 (C), each brightness division block BK is divided.
[0074] Passing through such processing, a microcomputer 70 asks for the index C1 which shows the number of the brightness division blocks with which the difference of the maximum of the brightness value of each pixel and the minimum value became below a predetermined threshold (40). Thereby, a microcomputer 70 makes homogeneity the brightness value of each pixel which constitutes a brightness division block.
[0075] In addition, an index C1 is not limited to the number of brightness division blocks which became the maximum of the brightness value of each pixel, and below a threshold predetermined in the difference of the minimum value. For example, an index C1 may be the variance of the brightness value of an image pick-up image. Moreover, an index C1 may be total of the high frequency component of the two-dimensional fast Fourier transform (FFT:Fast Fourier Transform) of an image pick-up image.
[0076] Moreover, as shown in drawing 12 R> 2 (C), it divided until the brightness division block BK became 1x1 pixel, but a microcomputer 70 may end division, when it becomes the magnitude (for example, 4x4 pixels) which divided the brightness division block BK and was defined beforehand.
[0077] Below, the operation of an index C2 is explained. In addition, although C2 which indicates that the number of red system division blocks mentioned the microcomputer 70 above for every predetermined field is calculated, it explains calculating an index C2 about Field B using the image pick-up image shown in drawing 13 (A) here.
[0078] A microcomputer 70 obtains an image pick-up image as made drive CCD camera 21 for obstruction photography, for example, shown in drawing 13 (A). And an image pick-up image as extracted 0.3 or more lightness and 0.1 or more saturation from the image pick-up image concerned, for example, shown in drawing 1313 (B) is obtained. Furthermore, a microcomputer 70 will obtain an image pick-up image as shown in drawing 13 (C), if 0.1 or less and 0.75 or more hues are extracted.
[0079] To an image pick-up image as shown in drawing 13 (C), a microcomputer 70 repeats block division so that the inside of the same red system division block may occupy only by the red system pixel, and as shown in drawing 13 (D), it acquires the red system division block which consisted of pixels (0) other than a red system pixel (1) or a red system pixel. And a microcomputer 70 asks for the index C2 which is the number of the red system division blocks which consisted of only red system pixels.
[0080] A microcomputer 70 calculates the environmental complexity C according to the formula (1) mentioned above using the index C2 which shows the number of the index C1 which shows the number of the brightness division blocks searched for, and red system division blocks, and shifts to a step ST 23. In addition, the value of the complexity C calculated as mentioned above changes with time of day, as shown in drawing 14 .
[0081] In addition, an index C2 may not be limited to the number of red system division blocks, and the following values are sufficient as it.
[0082] To the image pick-up image of a predetermined field, in Munsell color charts, a color chart may belong to 2.5RP, 5RP, 7.5RP, 10RP, 2.5R, 5R, 7.5R and 10R, 2.5YR, and 5YR, and a microcomputer 70 may extract only the pixel of two or more chromas and a three or more lightness red system. And what is necessary is just to let the number of the division blocks with which the inside of the same division block repeated dividing the above-mentioned division block, and was obtained in it until only the above-mentioned red system pixel consisted of only pixels other than a red system pixel be an index C2.
[0083] Moreover, to the image pick-up image of a predetermined field, in Munsell color charts, a color chart belongs to 2.5RP, 5RP, 7.5RP, 10RP, 2.5R, 5R, 7.5R and 10R, 2.5YR, and 5YR, and a microcomputer 70 extracts only the pixel of two or more chromas and a three or more lightness red system, and is good also considering the number of the pixels of the above-mentioned red system as an index C2. Or it is good also considering total of the distance of each red system pixel mentioned above from the center of an image pick-up image as an index C2.
[0084] At a step ST 23, a microcomputer 70 sets up the threshold th for judging an environmental recognition degree. A threshold th is set up so that it may change with environmental illuminances of the car exterior. The reason is that it may sense that the traffic environment of a driver is complicated, or may sense that it is simple when it is bright in the car exterior or it becomes dark, even if the value of Complexity C is fixed.
[0085] As shown in drawing 1515 , the threshold table which described the threshold th over an environmental illuminance is memorized by the microcomputer 70. According to drawing 15 , a threshold th becomes large at a fixed rate as it becomes the minimum value (fixed) and an environmental illuminance becomes large from S1 to S2, when an environmental illuminance is from zero to S1. And a threshold th becomes small at a fixed rate as it

becomes maximum (fixed) and an environmental illuminance becomes large from S3, when an environmental illuminance is from S2 to S3. In addition, the threshold table shown in drawing 15 is an example of the gestalt of this operation, and this invention is not limited to this.

[0086] Then, a microcomputer 70 sets up a threshold th with reference to the above-mentioned threshold table based on the environmental illuminance detected by the illuminance sensor 41. Furthermore, a microcomputer 70 can reset the maximum of a threshold th according to posture change of the actuation input value of a driver, or a driver.

[0087] First, a microcomputer 70 sets up the maximum of a threshold th according to the input value of a slider 51 prepared in the slider panel 50. For example, when the driver is sliding the slider 51 to the direction of "a a little more than", as shown in drawing 15 , as for a microcomputer 70, the maximum of a threshold th is set up greatly. On the contrary, when the driver is sliding the slider 51 to the direction of "weakness", as for a microcomputer 70, the maximum of a threshold th is set up small. In addition, when there is a slider 51 in the middle of "a little more than" and "weakness", a microcomputer 70 is good with the default threshold th set up based on the environmental illuminance.

[0088] Next, a microcomputer 70 sets up the maximum of a threshold th according to posture change of a driver. The reason is that a driver has the inclination to be easy to recognize various environments in the case where there is change of a posture frequently, and there is an inclination to be hard to recognize an environment, in the case where there is no change of a posture. Then, a microcomputer 70 sets up a threshold th as follows in consideration of the ease of carrying out of recognition of a traffic environment, and the relation of posture change of a driver.

[0089] When it judges with posture change of a driver being "smallness" in the step ST 21 mentioned above, a microcomputer 70 sets up the maximum of a threshold th small, as shown in drawing 16 . When it judges with posture change of a driver being "size" in a step ST 21 conversely, the maximum of a threshold th is set up greatly. In addition, a microcomputer 70 is good with the default threshold th set up based on the environmental illuminance, when it judges with posture change of a driver being "inside."

[0090] Thus, a microcomputer 70 will shift to a step ST 24, if a threshold th is further set up based on posture change of a driver with the threshold table on which the threshold th corresponding to an environmental illuminance was described, and the input value of a slider 51 prepared in the slider panel 50.

[0091] At a step ST 24, a microcomputer 70 compares the complexity C calculated at a step ST 22 with the threshold th set up at a step ST 23, as shown in drawing 17 . And when Complexity C is not over the threshold th, it judges with an environment being simple intricately. Moreover, when Complexity C is over the threshold th, it judges with an environment being complicated.

[0092] In the case of front scenery as judged as a traffic environment being "simple" in the case of front scenery as the image pick-up image obtained with CCD camera 21 for obstruction photography shows to drawing 18 , for example, shown in drawing 19 , a traffic environment judges that a microcomputer 70 is "complicated." And subroutine processing is ended and it shifts to the step ST 3 shown in drawing 3 .

[0093] ((ST) Step 3) At a step ST 3, a microcomputer 70 performs the alarm of an obstruction to a driver. Here, it judges whether there is any alarm request flag for every field, and a predetermined alarm is performed to a driver using the high flag of priority. In addition, the alarm request flag said here means the flag which shows that it is necessary to perform an alarm to a driver by existence of an obstruction etc. about the above-mentioned predetermined field. And a microcomputer 70 specifically performs processing from the step ST 31 shown in drawing 20 R> 0 to a step ST 42.

[0094] At a step ST 31, it judges whether a microcomputer 70 generates the alarm request flag of Field A. Here, the subroutine from the step ST 51 specifically shown in drawing 21 to a step ST 54 is performed.

[0095] At a step ST 51, a microcomputer 70 judges whether the obstruction was detected in Field A, or a current self-vehicle location is in obstruction appearance within the limits, when fulfilling one of conditions, it shifts to a step ST 52, and when fulfilling neither of the conditions, subroutine processing is ended.

[0096] At a step ST 52, a microcomputer 70 judges whether the self-vehicle has taken the evasive action to the obstruction based on the self-vehicle condition detected at the step ST 13 mentioned above, when having taken the evasive action, it shifts to a step ST 53, and when having not taken the evasive action, it ends subroutine processing.

[0097] At a step ST 53, it judges whether as for a microcomputer 70, it is impossible for a self-vehicle to avoid an obstruction based on the information and the self-vehicle condition about the obstruction detected in a step ST 1. And though the driver stepped on the brake pedal, for example, or the handle was operated and the evasive action over an obstruction is taken, when a self-vehicle cannot avoid an obstruction, it shifts to a step ST 54, and subroutine processing is ended when a self-vehicle can avoid an obstruction.

[0098] At a step ST 54, a microcomputer 70 generates the alarm request flag in Field A, and ends subroutine processing. A microcomputer 70 shifts to the step ST 32 shown in drawing 20 R> 0, after ending such subroutine processing.

[0099] At a step ST 32, it judges whether a microcomputer 70 generates an alarm request flag to each of Fields B, C, and D. Subroutine processing from the step ST 61 specifically shown in drawing 22 to a step ST 64 is performed. In addition, since the same processing is performed in any field here, processing of Field B is mentioned as an example and explained.
[0100] At a step ST 61, a microcomputer 70 judges whether the obstruction was detected in Field B, or a current self-vehicle location is in obstruction appearance within the limits, when fulfilling one of conditions, it shifts to a step ST 62, and when fulfilling neither of the conditions, subroutine processing is ended.
[0101] At a step ST 62, the complexity C of Field B judges whether the threshold th was exceeded in whether it judged that Field B is complicated and a step ST 2 in the step ST 2 which mentioned the microcomputer 70 above. And when the complexity C of Field B exceeds a threshold th, it shifts to a step ST 63, and subroutine processing is ended when it is not over the threshold th.
[0102] At a step ST 63, a microcomputer 70 judges whether it is the location where the location of an obstruction or the obstruction appearance range emits an alarm for the first time, when it is the location which emits an alarm for the first time, it shifts to a step ST 64, and when it is not the location which emits an alarm for the first time, it ends subroutine processing.
[0103] At a step ST 64, a microcomputer 70 generates the alarm request flag in Field B, and ends subroutine processing. A microcomputer 70 shifts to the step ST 33 shown in drawing 2020 , after ending the above subroutine processings.
[0104] At a step ST 33, a microcomputer 70 judges whether there is any alarm request flag of Field A, when there is an alarm request flag of Field A, it shifts to a step ST 39, and when there is no alarm request flag of Field A, it shifts to a step ST 34.
[0105] At a step ST 34, it judges whether a microcomputer 70 has the alarm request flag of Field C or Field D. And when an alarm request flag is at least in one side of each field, it shifts to a step ST 38, and when there is no alarm request flag in all of each field, it shifts to a step ST 35.
[0106] At a step ST 35, it judges whether a microcomputer 70 has the alarm request flag of Field B, when there is an alarm request flag of Field B, it shifts to a step ST 36, and when there is no alarm request flag of Field B, subroutine processing is ended.
[0107] Thus, a microcomputer 70 is performing processing in order of a step ST 33 to the step ST 35, sets up priority in order of Field A, Field C or Field D, and Field B, and is performing the alarm of an obstruction from the high field of priority.
[0108] At a step ST 36, a microcomputer 70 judges whether there was any alarm request flag of Field A by the last judgment processing, when there is an alarm request flag of Field A, it shifts to a step ST 37, and when there is no alarm request flag of Field A, it ends subroutine processing.
[0109] At a step ST 37, a microcomputer 70 performs the alarm of Field B to a driver. Notice a microcomputer 70 about "forward cardiac failure theory object as an alarm to a driver," "a crossing is approached. Be careful of a pedestrian's elutriation. Display " etc. on LCD61, or it is made to output from a loudspeaker 62 with voice, and subroutine processing is ended.
[0110] Moreover, at the step ST 38 when judging with there having been one [at least] alarm request flag of Field C and Field D, and shifting at a step ST 34, a microcomputer 70 performs an alarm to a driver about a field with an alarm request flag. As an example of an alarm request, it is the same as that of a step ST 37.
[0111] At the step ST 39 when judging with there having been an alarm request flag of Field A, and on the other hand, shifting at a step ST 33, it judges whether there is any alarm request flag of Field A more than a predetermined number, and an alarm request flag shifts to a step ST 40 more than a predetermined number at a certain time, and when there is no alarm request flag more than a predetermined number, it shifts to a step ST 42.
[0112] At a step ST 40, a microcomputer 70 judges whether the vehicle speed detected by the self-vehicle condition detecting element 30 is beyond a predetermined value, when the vehicle speed is beyond a predetermined value, it shifts to a step ST 41, and when the vehicle speed is not beyond a predetermined value, it shifts to a step ST 42.
[0113] At a step ST 41, a microcomputer 70 performs the 1st alarm in Field A to a driver. Microcomputers 70 are for example, "collision cautions as the 1st alarm to a driver. Please slow down. Display " etc. on LCD61, or it is made to output from a loudspeaker 62 with voice, and subroutine processing is ended.
[0114] At a step ST 42, a microcomputer 70 performs the 2nd alarm in Field A to a driver. A microcomputer 70 displays "please avoid an obstruction" etc. on LCD61, or is made to output from a loudspeaker 62 with voice as the 2nd alarm to a driver, and ends subroutine processing.
[0115] A microcomputer 70 ends the alarm to a driver, after ending subroutine processing of a step ST 3. Thus, a microcomputer 70 can prevent that control the alarm to a driver to the minimum, become a surfeit of information, and a driver gets confused by processing by setting priority as the alarm request flag of each field.
[0116] As mentioned above, the obstruction alarm 1 concerning the gestalt of the 1st operation can make a

driver recognize a migration obstruction, without confusing a driver by recognizing a migration obstruction automatically, presuming the range of a migration obstruction which can be appeared, and taking into consideration the recognition degree of the traffic environment of a driver in the appearance location of a migration obstruction further. Moreover, when there is much amount of information which a driver should be shown, the obstruction alarm 1 can be urged that the vehicle speed of a self-vehicle is reduced, and can prevent accident beforehand.

[0117] When an obstruction is detected also in any of Field A to the field D shown in drawing 10 , the obstruction alarm 1 gives top priority to the field A in front of a self-vehicle, and performs an alarm to the obstruction which exists in Field A. Thereby, the obstruction alarm 1 can avoid the crisis for which it pressed immediately before.

[0118] gestalt] of operation of others [[] -- below, the gestalt of other operations of this invention is explained. In addition, the sign same about the part which overlaps the gestalt of the 1st operation is attached, and detailed explanation is omitted.

[0119] (Mode of division of an image pick-up image) With the gestalt of the 1st operation As opposed to this which the microcomputer 70 divided the image pick-up field into four from Field A to Field D as shown in drawing 10 , and was calculating the index C1 and the index C2 in Field B, Field C, and Field D A microcomputer 70 may divide into four fields the image pick-up image shown in drawing 2323 (A), as shown in drawing 23 (B). That is, the microcomputer 70 is dividing the image pick-up image into four fields by dividing a rectangle-like image pick-up image along with the two diagonal lines. And what is necessary is just to calculate an index C1 and an index C2 about each field like the gestalt of the 1st operation.

[0120] Moreover, a microcomputer 70 may divide into four fields of a field (1), two fields (2), and a field (3) the image pick-up image shown in drawing 24 (A), as shown in drawing 24 (B). Here, a field (1) is a field which shows the car in front of Katanao in front of a self-vehicle. A field (2) is a field of both the outsides of a field (1). Fields (3) are fields other than a field (1) and a field (2).

[0121] A microcomputer 70 can divide a brightness division block to 1x1 pixel about a field (1), can divide it to 2x2 pixels about a field (2), can be divided to 2x2 pixels about a field (3), and can calculate an index C1 in each field. Furthermore, a microcomputer 70 can divide a red system division block to 1x1 pixel in each field, can obtain the image shown in drawing 24 (C), and can calculate an index C2 in each field.

[0122] Furthermore, a microcomputer 70 can also divide an image pick-up image as follows. For example, as shown in drawing 25 R> 5, an image pick-up image may be divided into a "bottom of screen", "middle of the screen", a "screen left", and "the method of the screen right." A "bottom of screen" is the field of the shape of a rectangle from 5 to 1/4 about 1/of lengthwise directions of the image pick-up image bottom. "Middle of the screen" is a triangle-like field, one side of the triangle adjoins a "bottom of screen", and the vertical angle of one side is located in the upper limit of an image pick-up screen. A "screen left" is the field of left-hand side trapezoidal shape among fields other than a "bottom of screen" and "middle of the screen." "The method of the screen right" is the field of right-hand side trapezoidal shape among fields other than a "bottom of screen" and "middle of the screen."

[0123] About middle of the screen, as shown in drawing 26 , you may divide further.

[0124] (Setup of a threshold th) You may make it set up a microcomputer 70 according to each input value of not only when setting up a threshold th like the gestalt of the 1st operation according to the input value of the slider 51 operated by the driver individual, but the slider 51 operated by two or more drivers.

[0125] Drawing 27 is drawing which plotted the environmental recognition degree inputted by the driver, when ten persons' driver is shown the image pick-up image of ten sheets. A microcomputer 70 can set up the appropriate threshold th by calculating the average of these values.

[0126] (Other operation technique of Complexity C) A microcomputer 70 calculates Complexity C according to a formula (1), and although the environmental recognition degree was presumed by comparing Complexity C with a threshold th, this invention is not limited to this.

[0127] A microcomputer 70 may memorize the recognition degree map in which the recognition degree determined by the index C1 and the index C2 is shown, as shown in drawing 28 R> 8. At this time, a microcomputer 70 calculates an index C1 and an index C2 like the gestalt of the 1st operation, and should just presume an environmental recognition degree with reference to the above-mentioned recognition degree map. For example, it can judge with it judging with an environmental recognition degree being high at the time of = (C1, C2) (a, b), and the environmental recognition degree of a microcomputer 70 being low when it is = (C1, C2) (c, d).

[0128] (Three-dimension spacial configuration) A microcomputer 70 divides an image pick-up image into a predetermined field beforehand, calculates an index C1 and an index C2 like the gestalt of the 1st operation for every predetermined field, and calculates an index C1 and C2 further to it. And an index C1, an index C2, an index C1, and C2 can be arranged to three-dimension vector space, as shown in drawing 29 , and the value (magnitude, sense) of the movement vector on each pixel can also be used as complexity C.

[0129] The 1st field presumed that an environmental recognition degree is low and the 2nd field presumed that an environmental recognition degree is high may be prepared in three-dimension vector space so that it may be shown at this time, for example, drawing 30 . If a microcomputer 70 is judged and Complexity C is in the 1st field, it will presume that the degree of a driver of environmental recognition is low, and if Complexity C is in the 2nd field, it can presume it that the degree of environmental recognition is [a driver] high to any of the above-mentioned field the complexity C called for using the above-mentioned three-dimension space belongs.
[0130] (Neural network) A microcomputer 70 may presume an environmental recognition degree using a neural network. Drawing 31 is the block diagram showing the functional configuration of the microcomputer 70 which presumes an environmental recognition degree using a neural network.
[0131] The microcomputer 70 is equipped with the neural network 71 which consists of a transform function which has the database which can be updated, the recognition degree presumption section 72 which presumes the recognition degree of the environment of a driver, and the computing element 73 which performs processing which subtracts estimate from an input value. In addition, the computing element 73 which may be equipped with a learning function with a statistical method subtracts the estimate of the recognition degree of the environment presumed in the recognition degree presumption section 72 instead of a neural network 71 from the input value of the slider 51 shown in drawing 2 . A neural network 71 is serially learned based on the subtraction value subtracted by the computing element 73, and Complexity C, and supplies the complexity [finishing / study] C to the recognition degree presumption section 72. The recognition degree presumption section 72 should just presume an environmental recognition degree for every driver using the complexity [finishing / the study from a neural network 71] C.
[0132] Consequently, a microcomputer 70 can be serially learned in consideration of actual environmental recognition of a driver, and can presume the recognition degree of a traffic environment correctly according to a driver individual's vision property.
[0133]
[Effect of the Invention] The environmental complexity arithmetic unit concerning this invention can ask for the complexity which shows the complexity of the difficulty of carrying out of environmental recognition, i.e., an environment, by calculating environmental complexity at least based on one side of distribution of change of the brightness contained in the image pick-up image generated with said image pick-up means, and distribution of the red system pixel contained in said image pick-up image.
[0134] The environmental recognition degree presumption equipment concerning this invention can presume the recognition degree of an observer's environment objective and correctly by presuming an environmental recognition degree based on the complexity calculated with the complexity arithmetic unit.
[0135] By performing the alarm about said obstruction, when it is presumed that the environmental recognition degree of the predetermined field which detects the location of an obstruction and includes the location of the detected obstruction is low, the obstruction alarm concerning this invention can carry out the alarm of the existence of the obstruction concerned to an observer, when an obstruction is in the low field of an environmental recognition degree. Since an alarm is not performed on the other hand when an obstruction is in the high field of an environmental recognition degree, an observer can prevent receiving troublesomeness with an excessive alarm.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to an environmental complexity arithmetic unit, environmental recognition degree presumption equipment, and an obstruction alarm, and relates to the environmental complexity arithmetic unit, the environmental recognition degree presumption equipment, and the obstruction alarm which offer obstruction recognition exchange of a driver especially according to the traffic environment of the perimeter of a car.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] The environmental complexity arithmetic unit concerning this invention can ask for the complexity which shows the complexity of the difficulty of carrying out of environmental recognition, i.e., an environment, by calculating environmental complexity at least based on one side of distribution of change of the brightness contained in the image pick-up image generated with said image pick-up means, and distribution of the red system pixel contained in said image pick-up image.
[0134] The environmental recognition degree presumption equipment concerning this invention can presume the recognition degree of an observer's environment objective and correctly by presuming an environmental recognition degree based on the complexity calculated with the complexity arithmetic unit.
[0135] By performing the alarm about said obstruction, when it is presumed that the environmental recognition degree of the predetermined field which detects the location of an obstruction and includes the location of the detected obstruction is low, the obstruction alarm concerning this invention can carry out the alarm of the existence of the obstruction concerned to an observer, when an obstruction is in the low field of an environmental recognition degree. Since an alarm is not performed on the other hand when an obstruction is in the high field of an environmental recognition degree, an observer can prevent receiving troublesomeness with an excessive alarm.

[Translation done.]

TECHNICAL PROBLEM

[Description of the Prior Art] In operation of a car, it is important to check elutriation from right and left in the time of rectilinear propagation of a car or to check a crossing object on either side to a travelling direction in the time of the right and left chip box of a car, when preventing accident. The mobile which jumps out of right and left, or is crossed can consider various things, such as a pedestrian, a two-flower vehicle, and a four-flower vehicle.

[0003] In JP,3-260813,A, the environmental recognition equipment which detects such a mobile is proposed. Environmental recognition equipment acquired profile information by extracting the difference and the closed interval field of lightness information, and recognizes the migration body from profile information. However, since the lighting conditions which surround a car change every moment and have the influence of disturbance light etc., it is rare to be able to extract a profile completely vividly. Therefore, since the above-mentioned environmental recognition equipment performs image recognition only using profile information, its correspondence to an environmental variation from the little of amount of information is weak. In the case where it is carried in a car and an obstruction etc. is detected especially, since it is influenced [which was mentioned above] greatly, it is hard to say that a mobile is detectable the optimal. Moreover, since the lightness which was easy to be influenced of a shadow, disturbance light, etc., and changed with disturbance light affects change of a center of gravity or area directly, the processing which extracts a direct closed interval from lightness information is difficult.

[0004] In addition, the detection technique which added internal information to profile information, such as template matching and texture matching, is also proposed. However, the processing time starts or there is a problem of taking the time and effort which prepares the huge information about a template beforehand.

[0005] Under such a background, it is derived from the technique which compresses image information, and the technique of catching the image pick-up information on a camera with distribution of lightness data is proposed in recent years.

[0006] In JP,11-142168,A, principal component analysis which is one of the multivariate analyses is performed, image pick-up information is mapped in the information space stretched with normalization principal component characteristic quantity, and the technique which improved the technique of carrying out image recognition is proposed by analyzing the behavior of the data in information space. This technique performs more robust environmental recognition for normalization principal component characteristic quantity using car movement information and actuation information. Moreover, in JP,2000-19259,A, the technique of recognizing a body using visible-ray image information and infrared image information other than the light is proposed.

[0007] However, these techniques are difficult to recognize a mobile, when many factors which bar recognition of bodies, such as a guard rail and a halt vehicle, exist. For example, there is a problem which cannot recognize the pedestrian in the foot walks or crossings other than on [through which a car passes] a road surface, and the pedestrian who has run out of between the standby location of a bicycle or a halt vehicle.

[0008] On the other hand, for example by JP,11-301343,A, the lighting system for cars which used not only the obstruction itself but the camera (light, infrared rays) and which predicts the appearance rate of a migration obstruction according to environmental (road configuration) recognition is proposed. Moreover, in JP,11-232569,A, the pedestrian alarm system with the equipment which sends to a vehicle side whether the pedestrian approached the crossing etc. is proposed. Furthermore, in JP,6-144129,A, the nudge assistant equipment which aims at a nudge by choosing at random one cautions item by which two or more preparation was carried out to the same condition of being careful, and reporting to a driver is proposed, without recognizing a migration obstruction positively.

[0009] Thus, the migration obstruction recognition exchange which offers obstruction recognition exchange to a driver is proposed by performing approach warning of the thing in consideration of the automatic recognition of a migration obstruction, and the appearance probability of a migration body, or a pedestrian etc.

[0010] However, finally the driver itself recognizes a migration obstruction. If the vision cognition of the driver and a cognitive property were not taken into consideration, since a lot of information was shown to the driver too much, a driver may be confused on the contrary. Moreover, although there are few amounts of information

presentation, they are inefficient. [of the approach of uniting a cautions item with a location and showing it at random]

[0011] This invention is proposed in order to solve the technical problem mentioned above, and it aims at offering the environmental complexity arithmetic unit, the environmental recognition degree presumption equipment, and the obstruction alarm which can offer obstruction recognition exchange efficiently and exactly, without showing a driver superfluous information.

[Translation done.]

MEANS

[Means for Solving the Problem] Invention according to claim 1 is equipped with a complexity operation means to calculate environmental complexity, at least based on one side of distribution of change of the brightness contained in the image pick-up image generated with an image pick-up means to generate an image pick-up image based on the image pick-up light from an environment, and said image pick-up means, and distribution of the red system pixel contained in said image pick-up image.

[0013] As for an image pick-up means, in invention according to claim 1, it is desirable to be installed so that a front traffic environment may be picturized for example, from a car front seat. A complexity operation means can ask for the spatial frequency which shows the complexity of an image from distribution of brightness change included in an image pick-up image. Moreover, a complexity operation means can ask for the complexity of an image from distribution of the red system pixel contained in an image pick-up image.

[0014] Invention according to claim 2 is set to invention according to claim 1. Said complexity operation means Until it sets a brightness division block as the image pick-up image generated with said image pick-up means and it is judged in the set-up brightness division block that the brightness value of each pixel is homogeneous It repeats dividing said brightness division block and setting up a new brightness division block, and is characterized by calculating environmental complexity to said image pick-up image based on the number of the brightness division blocks with which the brightness value of each pixel became homogeneity.

[0015] In invention according to claim 2, a complexity operation means sets up a brightness division block to an image pick-up image. The brightness division block set up first shows the field which calculates complexity. And said brightness division block is divided, the divided brightness division block is set up as a new brightness division block, and this processing is repeated until it is judged in a brightness division block that the brightness value of each pixel is homogeneous. Here, the difference of the maximum of not only when the brightness value of each pixel is in agreement in the brightness value of each pixel being homogeneous, but a brightness value and the minimum value of a brightness value should just be below a predetermined value. Namely, dispersion in the brightness value of each pixel has just become below a predetermined value.

[0016] And if it is judged that the brightness value of each pixel in all brightness division fields is homogeneous, it will ask for the number of these the brightness division blocks of all as environmental complexity. The number of such brightness division blocks supports spatial frequency. That is, if there are many totals, there are many high frequency components and an image pick-up image is complicated. Moreover, if there are few totals, there are few high frequency components and the image pick-up image is simple. Thus, it can ask for environmental complexity by asking for the number of brightness division blocks.

[0017] Invention according to claim 3 is set to invention according to claim 1. Said complexity operation means Until it sets a red system division block as the image pick-up image generated with said image pick-up means and the set-up red system division block consists of only predetermined red system pixels It repeats dividing said red system division block and setting up a new red system division block, and is characterized by calculating environmental complexity to said image pick-up image based on the number of the red system division blocks which consist of only said predetermined red system pixels.

[0018] In invention according to claim 3, a complexity operation means sets up a red system division block to an image pick-up image. The red system division block set up first shows the field which calculates complexity. The red system division block concerned is divided until a red system division block consists of only predetermined red system pixels. And the divided red system division block is set up as a new red system division block, and this processing is repeated. If all red system division blocks consist of only predetermined red system pixels, it will ask for the number of these the red system division blocks of all as environmental complexity. Red is compared green, and has the property that eye attractiveness is high, and, as for the number of red system division blocks, the complexity of an image is shown. Therefore, it can ask for environmental complexity by calculating the number of the above-mentioned red system division blocks.

[0019] Invention according to claim 4 is set to invention according to claim 1. Said complexity operation means Until it sets a brightness division block as the image pick-up image generated with said image pick-up means and it is judged in the set-up brightness division block that the brightness value of each pixel is homogeneous

Repeat dividing said brightness division block and setting up a new brightness division block, and said image pick-up image is received. Until it calculates the number of the brightness division blocks with which the brightness value of each pixel became homogeneity, it sets a red system division block as the image pick-up image generated with said image pick-up means and the set-up red system division block consists of only predetermined red system pixels Repeat dividing said red system division block and setting up a new red system division block, and said image pick-up image is received. It is characterized by calculating the number of the red system division blocks which consist of only said predetermined red system pixels, and calculating environmental complexity based on the number of said brightness division blocks, and the number of red system division blocks.

[0020] In invention according to claim 4, a complexity operation means asks for the number of brightness division blocks like invention according to claim 2, asks for the number of red system division blocks like invention according to claim 3 further, and asks for environmental complexity based on these totals. It is desirable to square a respectively predetermined weighting multiplier to the product of the number of brightness division blocks, the number of red system division blocks, the number of brightness division blocks, and the number of red system division blocks, and to ask for these total as environmental complexity, at it.
[0021] Invention according to claim 5 is equipped with an environmental recognition degree presumption means to presume an environmental recognition degree based on the complexity calculated with the complexity arithmetic unit and said complexity arithmetic unit of four given in any 1 term from claim 1.
[0022] In invention according to claim 5, since the complexity of an environmental image pick-up image is shown, the complexity calculated with the complexity arithmetic unit is used as a parameter for presuming the recognition degree of an observer's environment. That is, an environmental recognition degree presumption means can presume an environmental recognition degree based on the above-mentioned complexity.
[0023] It is characterized by presuming that the environmental recognition degree of invention according to claim 6 is low in invention according to claim 5 when the complexity which calculated said environmental recognition degree presumption means with said complexity arithmetic unit is beyond a threshold, and presuming that an environmental recognition degree is high when the complexity calculated with said complexity arithmetic unit is smaller than a threshold.
[0024] In invention according to claim 6, the threshold used as the reference value of an environmental recognition degree is set up. That is, a threshold is a value of the complexity which shows simple middle that an environment is complicated. Then, it presumes that the environmental recognition degree of an environmental recognition degree presumption means is low when complexity is beyond a threshold in using this threshold, and when complexity is smaller than a threshold, it can be presumed that an environmental recognition degree is high.
[0025] It is characterized by equipping invention according to claim 7 with an illuminance detection means to detect an environmental illuminance, further in invention according to claim 5 or 6, and for said environmental recognition degree presumption means setting up said threshold corresponding to the illuminance detected by said illuminance detection means, and presuming an environmental recognition degree using the set-up threshold.
[0026] In invention according to claim 7, even if complexity is fixed, when it is bright in the car exterior or it becomes dark, an observer may sense that an environment is complicated or may sense that it is simple. Then, in order to amend change of the recognition degree of the environment by change of such an illuminance, it is desirable to use the threshold table on which the threshold corresponding to an illuminance was described beforehand. Thereby, if an illuminance is detected by the illuminance detection means, the threshold corresponding to the detected illuminance can be set up. And an environmental recognition degree can be presumed using the set-up threshold. Consequently, no matter an illuminance may be what value, an environmental recognition degree can be presumed correctly.
[0027] Invention according to claim 8 is further equipped with a posture change detection means to detect posture change of an observer in invention of seven given in any 1 term from claim 5. Said environmental recognition degree presumption means It is characterized by presuming an environmental recognition degree using the threshold which set up the threshold greatly as posture change of an observer detected with said posture change detection means became large, set up the threshold small and was set up as posture change of an observer detected with said posture change detection means became small.
[0028] In invention according to claim 8, an observer has the degree which recognizes an environment in a high inclination, when posture change is large. By setting up a threshold greatly as posture change of an observer becomes large, and setting up a threshold small as posture change of an observer becomes small, an environmental recognition degree presumption means can presume an environmental recognition degree correctly so that it may agree in an observer's actual vision property.
[0029] The environmental recognition degree presumption equipment of eight given in any 1 term from claim 5 invention according to claim 9 presumes an environmental recognition degree to be for every predetermined

field, When a predetermined field including the location of the obstruction detected with an obstruction location detection means to detect the location of an obstruction, and said obstruction detection means is presumed that an environmental recognition degree is low by said environmental recognition degree presumption means, it has an alarm means to perform the alarm about said obstruction.

[0030] In invention according to claim 9, an obstruction location detection means detects the location of an obstruction. At this time, environmental recognition degree presumption equipment presumes the recognition degree of the environment of a predetermined field including the location where the obstruction was detected. Here, when an environmental recognition degree is high, an observer can recognize enough the obstruction detected by the obstruction location detection means. On the other hand, when an environmental recognition degree is low, an observer may be unable to recognize the obstruction detected by the obstruction location detection means. Then, an alarm means performs the alarm about an obstruction, when it is presumed that the environmental recognition degree of a predetermined field including the location of an obstruction is low. Thereby, even when an obstruction is in the field where an environmental recognition degree is low, an observer can recognize in advance that there is an obstruction and can avoid accident. In addition, when it is presumed that the environmental recognition degree of the predetermined [an observer can be made to call attention when an alarm means outputs an image or voice] field in which an alarm means includes the location of an obstruction again is high, the alarm about an obstruction is not performed. Thereby, in the case where an obstruction is in the field where an environmental recognition degree is high, since an observer can recognize the obstruction, he does not receive troublesomeness with an excessive alarm.

[0031] Invention according to claim 10 is set to invention according to claim 9. Said environmental recognition degree presumption equipment The field except the lower part of an image pick-up image is divided into two or more presumed fields, and an environmental recognition degree is presumed for every divided presumption field. Said alarm means When the location of the obstruction detected by said obstruction location detection means is in any of said presumed field and the recognition degree of the environment of the presumed field concerned is presumed to be low by said environmental recognition degree presumption means It is characterized by performing the alarm about the obstruction which exists in the high presumed field of a priority.

[0032] In invention according to claim 10, environmental recognition degree presumption equipment divides the field except the lower part of an image pick-up image into two or more presumed fields, and presumes an environmental recognition degree for every divided presumption field. That is, an environmental recognition degree is not presumed about the lower part of an image pick-up image. The lower part of an image pick-up screen shows the image of the environment in front of an observer, and the reason is that there is no semantics which presumes the degree of recognition of the environment.

[0033] It judges whether an alarm means has the location of the obstruction detected by said obstruction location detection means in any of said presumed field, and the recognition degree of the environment of the presumed field concerned was presumed to be low by said environmental recognition degree presumption means. Here, an obstruction is detected and an environmental recognition degree chooses all low presumption fields. And the alarm of a purport with which an obstruction exists is performed about the high presumed field of a priority among the selected appointed fields. While big accident is avoidable by making an observer careful of the thereby most dangerous field, about the field which is not not much dangerous, it can prevent an observer becoming a surfeit of information and getting confused by not reporting to an observer.

[0034]

[Embodiment of the Invention] It explains to a detail, referring to a drawing about the gestalt of desirable operation of this invention hereafter.

[0035] The gestalt of operation of the 1st of [gestalt of the 1st operation] this invention is applicable to the obstruction alarm 1 of a configuration of being shown in drawing 1 . The obstruction alarm 1 the infrastructure information which detects infrastructure information from the infrastructure of the car exterior The infrastructure information detecting element 10, The obstruction information detecting element 20 which detects a road and the information about the obstruction of the circumference of it, The self-vehicle condition detecting element 30 which detects the operating state of a self-car, and the environmental-information detecting element 40 which detects the environment of a driver or the car exterior, It has the slider panel 50 for inputting the vision property which shows the degree of environmental recognition of a driver, the obstruction information output section 60 which outputs obstruction information, and the microcomputer 70 which controls the whole based on the information detected in each part.

[0036] The infrastructure information detecting element 10 is equipped with the GPS receiving circuit 11 which receives a GPS (Global PositioningSystem) signal, the DVD drive 12 which reads the map information currently recorded on the DVD disk, and the approach information receiving circuit 13 which receives approach information.

[0037] The GPS receiving circuit 11 receives the GPS signal which has the positional information of time of day and a GPS Satellite through GPS antenna 11a, and supplies it to a microcomputer 70 through a data bus 5.

Based on the positional information which is carrying out current transit, a car reads map information from a DVD-disk, and supplies the DVD drive 12 to a microcomputer 70 through a data bus 5. The approach information receiving circuit 13 receives the approach information transmitted from the data carrier reader mentioned later, and supplies it to a microcomputer 70 through a data bus 5.

[0038] The obstruction information detecting element 20 is equipped with CCD camera 21 for obstruction photography for photoing the obstruction of a path on the street or the perimeter of a road, the infrared camera 22 for photoing the obstruction of a path on the street or the perimeter of a road with infrared radiation, and the radar transceiver 23 for recognizing a forward cardiac failure theory object.

[0039] CCD camera 21 for obstruction photography and the infrared camera 22 are installed so that the body of the direction of the car front can be picturized. And CCD camera 21 for obstruction photography and the infrared camera 22 supply the photoed photography image to a microcomputer 70 through a data bus 5. A radar transceiver 23 receives the optical radar reflected by the obstruction while extracting a pulse-like optical radar keenly to the obstruction concerned and transmitting in the two-dimensional direction, in order to recognize a forward cardiac failure theory object. in addition, a radar transceiver 23 may be a thing which does not restrict, but transmits and receives an electric-wave radar and which transmits and receives an optical radar.

[0040] The self-vehicle condition detecting element 30 is equipped with for example, a wheel speed sensor, a steering angle sensor, a throttle-valve sensor, the master cylinder oil pressure sensor, the yaw rate sensor, the order acceleration sensor, the lateral acceleration sensor, etc. And the self-vehicle condition detecting element 30 detects the vehicle speed, a handle steering include angle, an accelerator control input, the amount of brakes operation, a yaw rate, a roll rate, a pitch rate, order acceleration, lateral acceleration, and a winker control input, and supplies them to a microcomputer 70.

[0041] The environmental-information detecting element 40 is equipped with the illuminance sensor 41 which detects the illuminance of the car exterior, and CCD camera 42 for driver photography which photos a driver. Here, although only one CCD camera 42 for driver photography is formed, three CCD cameras which picturize the method of forward presence of a driver, the method of the forward right, and the method of the forward left, respectively may be formed so that posture change of a driver can be detected easily.

[0042] The slider panel 50 is for carrying out the actuation input of the vision property which shows the complexity of an external environment according to the subjectivity of a driver. As shown in the slider panel 50 and drawing 2 , it has the movable slider 51 right and left. A driver operates a slider 51 in the direction of "weakness", when he tends to overlook the traffic environment (i.e., when judging that it is hard to recognize the traffic environment of the car exterior). Moreover, a driver operates a slider 51 in the direction of "a little more than", when a traffic environment can be seen well (i.e., when it is easy to recognize the traffic environment of the car exterior). Although this mentions later in detail, a microcomputer 70 can presume an environmental recognition degree in consideration of the present vision property of a driver.

[0043] The obstruction information output section 60 is equipped with LCD (Liquid Crystal Display)61 which outputs obstruction information with an image, and the loudspeaker 62 which outputs obstruction information with voice.

[0044] The microcomputer 70 is constituted by CPU (Central Processing Unit) which is not illustrated, RAM (Random Access Memory) which is the work area of data, and ROM (Read Only Memory) the program and appearance range presumption table which perform various kinds of routine processings mentioned later, and the threshold table are remembered to be. A microcomputer 70 presumes an obstruction with appearance possibility based on the information from each part, presumes the environmental recognition degree of a driver, or performs the alarm of obstruction information.

[0045] (Main routine) In the obstruction alarm 1 constituted as mentioned above, a microcomputer 70 performs processing from the step ST 1 shown in drawing 3 to a step ST 3. Here, processing from a step ST 1 to a step ST 3 is explained briefly first, and the concrete subroutine of each processing is explained after that.

[0046] A microcomputer 70 presumes the obstruction which may appear in the travelling direction of a self-vehicle while detecting a self-vehicle location based on the information detected by the infrastructure information detecting element 10 (step ST 1). And the environmental recognition degree which shows whether the image pick-up image of the environment of the travelling direction of a self-vehicle is divided, and it is easy to recognize a driver for every divided field is presumed (step ST 2). Finally, a microcomputer 70 performs the alarm about an obstruction to a driver if needed based on obstruction information with appearance possibility, and the environmental recognition degree for every predetermined field with an image or voice (step ST 3).

[0047] ((ST) Step 1) At a step ST 1, a microcomputer 70 performs processing from the step ST 11 specifically shown in drawing 4 to a step ST 14 that the obstruction which may appear in the travelling direction of a self-vehicle should be presumed.

[0048] At a step ST 11, a microcomputer 70 is the circumference of a self-vehicle location, and detects the migration obstruction outside the field-of-view range of a driver while it detects the location of a self-vehicle. In addition, an infrastructure which is explained below, for example is used here.

[0049] For example, as shown in drawing 5 , the pedestrian is always carrying the goods (for example, cellular phone) with which the data carrier 16 was formed. Moreover, the data carrier 16 is formed in the two-flower vehicle or the four-flower vehicle. A data carrier 16 can output some kinds of approach information, and the data carrier 16 of a pedestrian, a two-flower vehicle, and a four-flower vehicle outputs approach information different, respectively. On the other hand, the data carrier reader 17 which receives approach information is installed in the bad crossing and bad zebra zone of a prospect. If a data carrier 16 approaches, the data carrier reader 17 will receive approach information, and will transmit this approach information to the obstruction alarm 1.
[0050] If the approach information transmitted from the data carrier reader 17 is received in the approach information receiving circuit 13, the microcomputer 70 of the obstruction alarm 1 can pinpoint the location of an obstruction, and can recognize any of a pedestrian, a two-flower vehicle, and a four-flower vehicle the obstruction is further.
[0051] And a microcomputer 70 is the circumference of a self-vehicle location, detects the migration obstruction outside the field-of-view range of a driver, and recognizes the classification (a man, a two flower vehicle, or a four flower vehicle) of the migration obstruction concerned while it detects the location of a self-vehicle based on the GPS signal received by the GPS receiving circuit 11, the map information read from the DVD drive 12, and the approach information received by the approach information receiving circuit 13.
[0052] Furthermore, a microcomputer 70 presumes the range where a migration obstruction on the street [around a self-vehicle] may appear based on the classification of a migration obstruction with reference to the appearance range presumption table shown in drawing 6 R> 6. For example, when the four-flower vehicle has been recognized as a migration obstruction, the four-flower vehicle concerned presumes that a microcomputer 70 may appear in a travelling direction within the limits of 10m from a current location. Moreover, when the pedestrian has been recognized as a migration obstruction, the pedestrian concerned presumes that it may appear in within the limits with a radius of 1m from the current position.
[0053] A microcomputer 70 sets up the system of coordinates (henceforth "self-vehicle circumference system of coordinates") which consist of a shaft which intersects perpendicularly with the travelling direction shaft and travelling direction shaft of a self-vehicle, describes the appearance possibility range of a migration obstruction to self-vehicle circumference system of coordinates, and shifts to a step ST 12.
[0054] At a step ST 12, a microcomputer 70 detects the obstruction in field-of-view within the limits of a driver. Here, a microcomputer 70 makes CCD camera 21 for obstruction photography, and the infrared camera 22 drive, and acquires the image pick-up image generated with CCD camera 21 for obstruction photography, and the infrared camera 22. And a migration obstruction is detected by obtaining the image which fully attached contrast for human being who poses a problem especially on insurance, or a vehicle with the other thing by asking for the difference of the image generated with each camera.
[0055] Moreover, based on the both-way time amount of the optical radar from transmission by the radar transceiver 23 to reception, a microcomputer 70 obtains the depth map of the forward cardiac failure theory object of a self-vehicle, and recognizes a forward cardiac failure theory object. A microcomputer 70 describes the migration obstruction recognized by doing in this way to self-vehicle circumference system of coordinates, and shifts to a step ST 13.
[0056] At a step ST 13, a microcomputer 70 detects a self-vehicle condition based on the information from the self-vehicle condition detecting element 30. Here, a microcomputer 70 detects the vehicle speed, a handle steering include angle, an accelerator control input, the amount of brakes operation, a yaw rate, a roll rate, a pitch rate, order acceleration, lateral acceleration, and a winker control input, presumes the travelling direction of a self-vehicle, describes the presumed result of the travelling direction of a self-vehicle to self-vehicle circumference system of coordinates, and shifts to a step ST 14 as indicated by JP,11-301343,A, for example.
[0057] At a step ST 14, a microcomputer 70 leaves only the information on a migration obstruction that it may appear in advance prediction within the limits of a self-vehicle, to the self-vehicle circumference system of coordinates obtained by processing from a step ST 11 to a step ST 13, and removes the information on other. And if a microcomputer 70 is displayed on LCD61 by using as an obstruction display screen information about the migration obstruction described by self-vehicle circumference system of coordinates, it will shift to the step ST 2 which escaped from the subroutine and was shown in drawing 3 .
[0058] Here, the obstruction display screen shows the map of the perimeter the self-vehicle is running, the current position of a self-vehicle, the advance prediction range of a self-vehicle, and migration obstructions (people, vehicle, etc.) and the range of those which can be appeared, as shown in drawing 7 . The magnitude of the migration obstruction displayed on the obstruction display screen shows the range where the migration obstruction concerned may appear.
[0059] ((ST) Step 2) At a step ST 2, a microcomputer 70 performs processing from the step ST 21 specifically shown in drawing 8 to a step ST 24 that the degree a driver recognizes a perimeter [car] environment to be should be presumed.
[0060] At a step ST 21, a microcomputer 70 detects change of the posture of a driver using the information

from the environmental-information detecting element 40. namely, the microcomputer 70 -- the image pick-up image from CCD camera 42 for driver photography -- inter-frame [every] -- difference -- asking -- the difference of an image pick-up image -- a value is detected as migration space quantity of a driver.
[0061] A microcomputer 70 counts "1", when migration space quantity is beyond a predetermined threshold, and when migration space quantity is smaller than a predetermined threshold, it does not count. And the counted value concerned is one or more thresholds TH, the counted value for the past 5 minutes is calculated, for example, when the counted value concerned is less than one threshold TH, it judges with posture change being "smallness", when it is under the threshold TH2 (> TH1), it judges with posture change being "inside", and when the counted value concerned is two or more thresholds TH, it judges with posture change being "size." Moreover, a microcomputer 70 acquires the illuminance of the car exterior detected by the illuminance sensor 41, and shifts to a step ST 22.
[0062] At a step ST 22, a microcomputer 70 calculates the environmental complexity C for every predetermined field of the obstruction display screen shown in drawing 7 . In addition, the complexity C said here means the parameter used in order to presume the recognition degree of the traffic environment of a driver.
[0063] First, a microcomputer 70 quadrisects the field which has an obstruction and its range which can be appeared among the obstruction display screens obtained at a step ST 1 in distance and a direction. Here, as shown in drawing 9 , the obstruction display screen is divided into Field A, Field B, Field C, and Field D. Thereby, the above-mentioned obstruction display screen adjoins Field A and Field A which are a field of the front transverse-plane short distance of a self-vehicle, adjoins Field B and Fields A and B which are fields of a front transverse-plane long distance of a self-vehicle, adjoins Field C and Fields A and B which are fields of a front left long distance of a self-vehicle, and has the field D which is a field of a front right long distance of a self-vehicle. In addition, from the obstruction display screen field A, typically, Field D is divided, as shown in drawing 10 .
[0064] Next, a microcomputer 70 calculates the complexity C of a traffic environment about each of Field B, Field C, and Field D based on the following formula (1).
[0065]
[Equation 1]

$$C = \alpha \cdot C1 + \beta \cdot C2 + \gamma \cdot C1C2 \qquad \cdots\cdots (1)$$

[0066] An index C1 shows the number of brightness division blocks, and the index C2 shows the number of red system division blocks. Moreover, alpha, beta, and gamma are weighting multipliers and take a predetermined value, respectively.
[0067] Here, the operation of an index C1 is explained. In addition, although a microcomputer 70 calculates an index C1 about Field B, Field C, and Field D as mentioned above, it explains calculating an index C1 using the image pick-up image shown in drawing 11 about Field B here.
[0068] A microcomputer 70 obtains an image pick-up image as made drive CCD camera 21 for obstruction photography, for example, shown in drawing 11 . And the whole image pick-up image concerned is set up as a brightness division block.
[0069] A microcomputer 70 calculates the difference of the maximum of the brightness value of each pixel, and the minimum value in the set-up brightness division block. A microcomputer 70 judges whether they are the maximum of a brightness value, and beyond a threshold predetermined in the difference of the minimum value, and when the above-mentioned difference is over the predetermined threshold, it divides a brightness division block into four. At this time, as for a microcomputer 70, it is desirable to divide a brightness division block so that it may consist of almost same numbers of pixels in every direction, and so that it may enlarge as much as possible.
[0070] When the brightness value of an image pick-up image shows drawing 12 (A), a microcomputer 70 calculates the difference of the maximum (180) of a brightness value, and the minimum value (000). And since it judged whether the difference (180) of the maximum of a brightness value and the minimum value was beyond a threshold (for example, 40) and the above-mentioned difference is over the threshold (40) here, as shown in drawing 12 (A), a brightness division block is divided into four.
[0071] A microcomputer 70 divides said brightness division block into four, and repeats setting up a new brightness division block until the difference of the maximum of the brightness value of each pixel and the minimum value becomes below a predetermined threshold in each divided brightness division block.
[0072] For example, the brightness division block BK1 shown in drawing 12 (A) consists of 4x4 pixels, and the minimum value of 180 and a brightness value of the maximum of a brightness value is 20. A microcomputer 70 searches for the difference (160) of the maximum of the brightness value of the brightness division block BK1, and the minimum value, and since the above-mentioned difference is beyond a threshold (40), as shown in drawing 12 (B), it divides the brightness division block BK1 into four (BK2, BK3, BK4, BK5).
[0073] And since the difference (39) of the maximum of the brightness value of the brightness division block BK2

and the minimum value is not beyond a threshold (40), a microcomputer 70 does not divide to the brightness division block BK2. On the other hand, about the brightness division blocks BK3, BK4, and BK5, since the difference of the maximum of a brightness value and the minimum value is beyond a threshold (40), as shown in drawing 1212 (C), each brightness division block BK is divided.

[0074] Passing through such processing, a microcomputer 70 asks for the index C1 which shows the number of the brightness division blocks with which the difference of the maximum of the brightness value of each pixel and the minimum value became below a predetermined threshold (40). Thereby, a microcomputer 70 makes homogeneity the brightness value of each pixel which constitutes a brightness division block.

[0075] In addition, an index C1 is not limited to the number of brightness division blocks which became the maximum of the brightness value of each pixel, and below a threshold predetermined in the difference of the minimum value. For example, an index C1 may be the variance of the brightness value of an image pick-up image. Moreover, an index C1 may be total of the high frequency component of the two-dimensional fast Fourier transform (FFT:Fast Fourier Transform) of an image pick-up image.

[0076] Moreover, as shown in drawing 12 R> 2 (C), it divided until the brightness division block BK became 1x1 pixel, but a microcomputer 70 may end division, when it becomes the magnitude (for example, 4x4 pixels) which divided the brightness division block BK and was defined beforehand.

[0077] Below, the operation of an index C2 is explained. In addition, although C2 which indicates that the number of red system division blocks mentioned the microcomputer 70 above for every predetermined field is calculated, it explains calculating an index C2 about Field B using the image pick-up image shown in drawing 13 (A) here.

[0078] A microcomputer 70 obtains an image pick-up image as made drive CCD camera 21 for obstruction photography, for example, shown in drawing 13 (A). And an image pick-up image as extracted 0.3 or more lightness and 0.1 or more saturation from the image pick-up image concerned, for example, shown in drawing 1313 (B) is obtained. Furthermore, a microcomputer 70 will obtain an image pick-up image as shown in drawing 13 (C), if 0.1 or less and 0.75 or more hues are extracted.

[0079] To an image pick-up image as shown in drawing 13 (C), a microcomputer 70 repeats block division so that the inside of the same red system division block may occupy only by the red system pixel, and as shown in drawing 13 (D), it acquires the red system division block which consisted of pixels (0) other than a red system pixel (1) or a red system pixel. And a microcomputer 70 asks for the index C2 which is the number of the red system division blocks which consisted of only red system pixels.

[0080] A microcomputer 70 calculates the environmental complexity C according to the formula (1) mentioned above using the index C2 which shows the number of the index C1 which shows the number of the brightness division blocks searched for, and red system division blocks, and shifts to a step ST 23. In addition, the value of the complexity C calculated as mentioned above changes with time of day, as shown in drawing 14 .

[0081] In addition, an index C2 may not be limited to the number of red system division blocks, and the following values are sufficient as it.

[0082] To the image pick-up image of a predetermined field, in Munsell color charts, a color chart may belong to 2.5RP, 5RP, 7.5RP, 10RP, 2.5R, 5R, 7.5R and 10R, 2.5YR, and 5YR, and a microcomputer 70 may extract only the pixel of two or more chromas and a three or more lightness red system. And what is necessary is just to let the number of the division blocks with which the inside of the same division block repeated dividing the above-mentioned division block, and was obtained in it until only the above-mentioned red system pixel consisted of only pixels other than a red system pixel be an index C2.

[0083] Moreover, to the image pick-up image of a predetermined field, in Munsell color charts, a color chart belongs to 2.5RP, 5RP, 7.5RP, 10RP, 2.5R, 5R, 7.5R and 10R, 2.5YR, and 5YR, and a microcomputer 70 extracts only the pixel of two or more chromas and a three or more lightness red system, and is good also considering the number of the pixels of the above-mentioned red system as an index C2. Or it is good also considering total of the distance of each red system pixel mentioned above from the center of an image pick-up image as an index C2.

[0084] At a step ST 23, a microcomputer 70 sets up the threshold th for judging an environmental recognition degree. A threshold th is set up so that it may change with environmental illuminances of the car exterior. The reason is that it may sense that the traffic environment of a driver is complicated, or may sense that it is simple when it is bright in the car exterior or it becomes dark, even if the value of Complexity C is fixed.

[0085] As shown in drawing 1515 , the threshold table which described the threshold th over an environmental illuminance is memorized by the microcomputer 70. According to drawing 15 , a threshold th becomes large at a fixed rate as it becomes the minimum value (fixed) and an environmental illuminance becomes large from S1 to S2, when an environmental illuminance is from zero to S1. And a threshold th becomes small at a fixed rate as it becomes maximum (fixed) and an environmental illuminance becomes large from S3, when an environmental illuminance is from S2 to S3. In addition, the threshold table shown in drawing 15 is an example of the gestalt of this operation, and this invention is not limited to this.

[0086] Then, a microcomputer 70 sets up a threshold th with reference to the above-mentioned threshold table

based on the environmental illuminance detected by the illuminance sensor 41. Furthermore, a microcomputer 70 can reset the maximum of a threshold th according to posture change of the actuation input value of a driver, or a driver.

[0087] First, a microcomputer 70 sets up the maximum of a threshold th according to the input value of a slider 51 prepared in the slider panel 50. For example, when the driver is sliding the slider 51 to the direction of "a a little more than", as shown in drawing 15 , as for a microcomputer 70, the maximum of a threshold th is set up greatly. On the contrary, when the driver is sliding the slider 51 to the direction of "weakness", as for a microcomputer 70, the maximum of a threshold th is set up small. In addition, when there is a slider 51 in the middle of "a little more than" and "weakness", a microcomputer 70 is good with the default threshold th set up based on the environmental illuminance.

[0088] Next, a microcomputer 70 sets up the maximum of a threshold th according to posture change of a driver. The reason is that a driver has the inclination to be easy to recognize various environments in the case where there is change of a posture frequently, and there is an inclination to be hard to recognize an environment, in the case where there is no change of a posture. Then, a microcomputer 70 sets up a threshold th as follows in consideration of the ease of carrying out of recognition of a traffic environment, and the relation of posture change of a driver.

[0089] When it judges with posture change of a driver being "smallness" in the step ST 21 mentioned above, a microcomputer 70 sets up the maximum of a threshold th small, as shown in drawing 16 . When it judges with posture change of a driver being "size" in a step ST 21 conversely, the maximum of a threshold th is set up greatly. In addition, a microcomputer 70 is good with the default threshold th set up based on the environmental illuminance, when it judges with posture change of a driver being "inside."

[0090] Thus, a microcomputer 70 will shift to a step ST 24, if a threshold th is further set up based on posture change of a driver with the threshold table on which the threshold th corresponding to an environmental illuminance was described, and the input value of a slider 51 prepared in the slider panel 50.

[0091] At a step ST 24, a microcomputer 70 compares the complexity C calculated at a step ST 22 with the threshold th set up at a step ST 23, as shown in drawing 17 . And when Complexity C is not over the threshold th, it judges with an environment being simple intricately. Moreover, when Complexity C is over the threshold th, it judges with an environment being complicated.

[0092] In the case of front scenery as judged as a traffic environment being "simple" in the case of front scenery as the image pick-up image obtained with CCD camera 21 for obstruction photography shows to drawing 18 , for example, shown in drawing 19 , a traffic environment judges that a microcomputer 70 is "complicated." And subroutine processing is ended and it shifts to the step ST 3 shown in drawing 3 .

[0093] ((ST) Step 3) At a step ST 3, a microcomputer 70 performs the alarm of an obstruction to a driver. Here, it judges whether there is any alarm request flag for every field, and a predetermined alarm is performed to a driver using the high flag of priority. In addition, the alarm request flag said here means the flag which shows that it is necessary to perform an alarm to a driver by existence of an obstruction etc. about the above-mentioned predetermined field. And a microcomputer 70 specifically performs processing from the step ST 31 shown in drawing 20 R> 0 to a step ST 42.

[0094] At a step ST 31, it judges whether a microcomputer 70 generates the alarm request flag of Field A. Here, the subroutine from the step ST 51 specifically shown in drawing 21 to a step ST 54 is performed.

[0095] At a step ST 51, a microcomputer 70 judges whether the obstruction was detected in Field A, or a current self-vehicle location is in obstruction appearance within the limits, when fulfilling one of conditions, it shifts to a step ST 52, and when fulfilling neither of the conditions, subroutine processing is ended.

[0096] At a step ST 52, a microcomputer 70 judges whether the self-vehicle has taken the evasive action to the obstruction based on the self-vehicle condition detected at the step ST 13 mentioned above, when having taken the evasive action, it shifts to a step ST 53, and when having not taken the evasive action, it ends subroutine processing.

[0097] At a step ST 53, it judges whether as for a microcomputer 70, it is impossible for a self-vehicle to avoid an obstruction based on the information and the self-vehicle condition about the obstruction detected in a step ST 1. And though the driver stepped on the brake pedal, for example, or the handle was operated and the evasive action over an obstruction is taken, when a self-vehicle cannot avoid an obstruction, it shifts to a step ST 54, and subroutine processing is ended when a self-vehicle can avoid an obstruction.

[0098] At a step ST 54, a microcomputer 70 generates the alarm request flag in Field A, and ends subroutine processing. A microcomputer 70 shifts to the step ST 32 shown in drawing 20 R> 0, after ending such subroutine processing.

[0099] At a step ST 32, it judges whether a microcomputer 70 generates an alarm request flag to each of Fields B, C, and D. Subroutine processing from the step ST 61 specifically shown in drawing 22 to a step ST 64 is performed. In addition, since the same processing is performed in any field here, processing of Field B is mentioned as an example and explained.

[0100] At a step ST 61, a microcomputer 70 judges whether the obstruction was detected in Field B, or a current self-vehicle location is in obstruction appearance within the limits, when fulfilling one of conditions, it shifts to a step ST 62, and when fulfilling neither of the conditions, subroutine processing is ended.
[0101] At a step ST 62, the complexity C of Field B judges whether the threshold th was exceeded in whether it judged that Field B is complicated and a step ST 2 in the step ST 2 which mentioned the microcomputer 70 above. And when the complexity C of Field B exceeds a threshold th, it shifts to a step ST 63, and subroutine processing is ended when it is not over the threshold th.
[0102] At a step ST 63, a microcomputer 70 judges whether it is the location where the location of an obstruction or the obstruction appearance range emits an alarm for the first time, when it is the location which emits an alarm for the first time, it shifts to a step ST 64, and when it is not the location which emits an alarm for the first time, it ends subroutine processing.
[0103] At a step ST 64, a microcomputer 70 generates the alarm request flag in Field B, and ends subroutine processing. A microcomputer 70 shifts to the step ST 33 shown in drawing 2020 , after ending the above subroutine processings.
[0104] At a step ST 33, a microcomputer 70 judges whether there is any alarm request flag of Field A, when there is an alarm request flag of Field A, it shifts to a step ST 39, and when there is no alarm request flag of Field A, it shifts to a step ST 34.
[0105] At a step ST 34, it judges whether a microcomputer 70 has the alarm request flag of Field C or Field D. And when an alarm request flag is at least in one side of each field, it shifts to a step ST 38, and when there is no alarm request flag in all of each field, it shifts to a step ST 35.
[0106] At a step ST 35, it judges whether a microcomputer 70 has the alarm request flag of Field B, when there is an alarm request flag of Field B, it shifts to a step ST 36, and when there is no alarm request flag of Field B, subroutine processing is ended.
[0107] Thus, a microcomputer 70 is performing processing in order of a step ST 33 to the step ST 35, sets up priority in order of Field A, Field C or Field D, and Field B, and is performing the alarm of an obstruction from the high field of priority.
[0108] At a step ST 36, a microcomputer 70 judges whether there was any alarm request flag of Field A by the last judgment processing, when there is an alarm request flag of Field A, it shifts to a step ST 37, and when there is no alarm request flag of Field A, it ends subroutine processing.
[0109] At a step ST 37, a microcomputer 70 performs the alarm of Field B to a driver. Notice a microcomputer 70 about "forward cardiac failure theory object as an alarm to a driver," "a crossing is approached. Be careful of a pedestrian's elutriation. Display " etc. on LCD61, or it is made to output from a loudspeaker 62 with voice, and subroutine processing is ended.
[0110] Moreover, at the step ST 38 when judging with there having been one [at least] alarm request flag of Field C and Field D, and shifting at a step ST 34, a microcomputer 70 performs an alarm to a driver about a field with an alarm request flag. As an example of an alarm request, it is the same as that of a step ST 37.
[0111] At the step ST 39 when judging with there having been an alarm request flag of Field A, and on the other hand, shifting at a step ST 33, it judges whether there is any alarm request flag of Field A more than a predetermined number, and an alarm request flag shifts to a step ST 40 more than a predetermined number at a certain time, and when there is no alarm request flag more than a predetermined number, it shifts to a step ST 42.
[0112] At a step ST 40, a microcomputer 70 judges whether the vehicle speed detected by the self-vehicle condition detecting element 30 is beyond a predetermined value, when the vehicle speed is beyond a predetermined value, it shifts to a step ST 41, and when the vehicle speed is not beyond a predetermined value, it shifts to a step ST 42.
[0113] At a step ST 41, a microcomputer 70 performs the 1st alarm in Field A to a driver. Microcomputers 70 are for example, "collision cautions as the 1st alarm to a driver. Please slow down. Display " etc. on LCD61, or it is made to output from a loudspeaker 62 with voice, and subroutine processing is ended.
[0114] At a step ST 42, a microcomputer 70 performs the 2nd alarm in Field A to a driver. A microcomputer 70 displays "please avoid an obstruction" etc. on LCD61, or is made to output from a loudspeaker 62 with voice as the 2nd alarm to a driver, and ends subroutine processing.
[0115] A microcomputer 70 ends the alarm to a driver, after ending subroutine processing of a step ST 3. Thus, a microcomputer 70 can prevent that control the alarm to a driver to the minimum, become a surfeit of information, and a driver gets confused by processing by setting priority as the alarm request flag of each field.
[0116] As mentioned above, the obstruction alarm 1 concerning the gestalt of the 1st operation can make a driver recognize a migration obstruction, without confusing a driver by recognizing a migration obstruction automatically, presuming the range of a migration obstruction which can be appeared, and taking into consideration the recognition degree of the traffic environment of a driver in the appearance location of a migration obstruction further. Moreover, when there is much amount of information which a driver should be

shown, the obstruction alarm 1 can be urged that the vehicle speed of a self-vehicle is reduced, and can prevent accident beforehand.
[0117] When an obstruction is detected also in any of Field A to the field D shown in drawing 10 , the obstruction alarm 1 gives top priority to the field A in front of a self-vehicle, and performs an alarm to the obstruction which exists in Field A. Thereby, the obstruction alarm 1 can avoid the crisis for which it pressed immediately before.
[0118] gestalt] of operation of others [[] -- below, the gestalt of other operations of this invention is explained. In addition, the sign same about the part which overlaps the gestalt of the 1st operation is attached, and detailed explanation is omitted.
[0119] (Mode of division of an image pick-up image) With the gestalt of the 1st operation As opposed to this which the microcomputer 70 divided the image pick-up field into four from Field A to Field D as shown in drawing 10 , and was calculating the index C1 and the index C2 in Field B, Field C, and Field D A microcomputer 70 may divide into four fields the image pick-up image shown in drawing 2323 (A), as shown in drawing 23 (B). That is, the microcomputer 70 is dividing the image pick-up image into four fields by dividing a rectangle-like image pick-up image along with the two diagonal lines. And what is necessary is just to calculate an index C1 and an index C2 about each field like the gestalt of the 1st operation.
[0120] Moreover, a microcomputer 70 may divide into four fields of a field (1), two fields (2), and a field (3) the image pick-up image shown in drawing 24 (A), as shown in drawing 24 (B). Here, a field (1) is a field which shows the car in front of Katanao in front of a self-vehicle. A field (2) is a field of both the outsides of a field (1). Fields (3) are fields other than a field (1) and a field (2).
[0121] A microcomputer 70 can divide a brightness division block to 1x1 pixel about a field (1), can divide it to 2x2 pixels about a field (2), can be divided to 2x2 pixels about a field (3), and can calculate an index C1 in each field. Furthermore, a microcomputer 70 can divide a red system division block to 1x1 pixel in each field, can obtain the image shown in drawing 24 (C), and can calculate an index C2 in each field.
[0122] Furthermore, a microcomputer 70 can also divide an image pick-up image as follows. For example, as shown in drawing 25 R> 5, an image pick-up image may be divided into a "bottom of screen", "middle of the screen", a "screen left", and "the method of the screen right." A "bottom of screen" is the field of the shape of a rectangle from 5 to 1/4 about 1/of lengthwise directions of the image pick-up image bottom. "Middle of the screen" is a triangle-like field, one side of the triangle adjoins a "bottom of screen", and the vertical angle of one side is located in the upper limit of an image pick-up screen. A "screen left" is the field of left-hand side trapezoidal shape among fields other than a "bottom of screen" and "middle of the screen." "The method of the screen right" is the field of right-hand side trapezoidal shape among fields other than a "bottom of screen" and "middle of the screen."
[0123] About middle of the screen, as shown in drawing 26 , you may divide further.
[0124] (Setup of a threshold th) You may make it set up a microcomputer 70 according to each input value of not only when setting up a threshold th like the gestalt of the 1st operation according to the input value of the slider 51 operated by the driver individual, but the slider 51 operated by two or more drivers.
[0125] Drawing 27 is drawing which plotted the environmental recognition degree inputted by the driver, when ten persons' driver is shown the image pick-up image of ten sheets. A microcomputer 70 can set up the appropriate threshold th by calculating the average of these values.
[0126] (Other operation technique of Complexity C) A microcomputer 70 calculates Complexity C according to a formula (1), and although the environmental recognition degree was presumed by comparing Complexity C with a threshold th, this invention is not limited to this.
[0127] A microcomputer 70 may memorize the recognition degree map in which the recognition degree determined by the index C1 and the index C2 is shown, as shown in drawing 28 R> 8. At this time, a microcomputer 70 calculates an index C1 and an index C2 like the gestalt of the 1st operation, and should just presume an environmental recognition degree with reference to the above-mentioned recognition degree map. For example, it can judge with it judging with an environmental recognition degree being high at the time of = (C1, C2) (a, b), and the environmental recognition degree of a microcomputer 70 being low when it is = (C1, C2) (c, d).

[0128] (Three-dimension spacial configuration) A microcomputer 70 divides an image pick-up image into a predetermined field beforehand, calculates an index C1 and an index C2 like the gestalt of the 1st operation for every predetermined field, and calculates an index C1 and C2 further to it. And an index C1, an index C2, an index C1, and C2 can be arranged to three-dimension vector space, as shown in drawing 29 , and the value (magnitude, sense) of the movement vector on each pixel can also be used as complexity C.
[0129] The 1st field presumed that an environmental recognition degree is low and the 2nd field presumed that an environmental recognition degree is high may be prepared in three-dimension vector space so that it may be shown at this time, for example, drawing 30 . If a microcomputer 70 is judged and Complexity C is in the 1st field, it will presume that the degree of a driver of environmental recognition is low, and if Complexity C is in the 2nd

field, it can presume it that the degree of environmental recognition is [a driver] high to any of the above-mentioned field the complexity C called for using the above-mentioned three-dimension space belongs.
[0130] (Neural network) A microcomputer 70 may presume an environmental recognition degree using a neural network. Drawing 31 is the block diagram showing the functional configuration of the microcomputer 70 which presumes an environmental recognition degree using a neural network.
[0131] The microcomputer 70 is equipped with the neural network 71 which consists of a transform function which has the database which can be updated, the recognition degree presumption section 72 which presumes the recognition degree of the environment of a driver, and the computing element 73 which performs processing which subtracts estimate from an input value. In addition, the computing element 73 which may be equipped with a learning function with a statistical method subtracts the estimate of the recognition degree of the environment presumed in the recognition degree presumption section 72 instead of a neural network 71 from the input value of the slider 51 shown in drawing 2 . A neural network 71 is serially learned based on the subtraction value subtracted by the computing element 73, and Complexity C, and supplies the complexity [finishing / study] C to the recognition degree presumption section 72. The recognition degree presumption section 72 should just presume an environmental recognition degree for every driver using the complexity [finishing / the study from a neural network 71] C.
[0132] Consequently, a microcomputer 70 can be serially learned in consideration of actual environmental recognition of a driver, and can presume the recognition degree of a traffic environment correctly according to a driver individual's vision property.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the obstruction alarm concerning the gestalt of operation of this invention.
[Drawing 2] It is drawing showing the configuration of the slider panel with which the obstruction alarm was equipped.
[Drawing 3] It is the flow chart which shows the main routine of the operations sequence of the microcomputer with which the obstruction alarm was equipped.
[Drawing 4] It is the flow chart which shows the concrete operations sequence of the step ST 1 in a main routine.
[Drawing 5] It is drawing for explaining the outline of a data carrier and a data carrier reader.
[Drawing 6] It is drawing showing the appearance range presumption table memorized by the microcomputer.
[Drawing 7] It is drawing showing the obstruction display screen displayed on LCD.
[Drawing 8] It is the flow chart which shows the concrete operations sequence of the step ST 2 in a main routine.
[Drawing 9] It is drawing explaining the condition of having divided the obstruction display screen into Field D from Field A.
[Drawing 10] It is drawing explaining the condition of having divided the obstruction display screen into Field D from Field A typically.
[Drawing 11] It is drawing showing an example of the image pick-up image when calculating an index C1 in Field B.
[Drawing 12] It is drawing showing an example of the brightness value of an image pick-up image.
[Drawing 13] It is drawing showing an example of an image pick-up image.
[Drawing 14] Complexity C is drawing explaining the condition of changing with time of day.
[Drawing 15] It is drawing showing the threshold table on which the threshold over an environmental illuminance was described.
[Drawing 16] It is drawing explaining the condition that a threshold th changes according to posture change of a driver.
[Drawing 17] It is drawing for comparing Complexity C with a threshold th and presuming an environmental recognition degree.
[Drawing 18] A traffic environment is drawing showing an example of a simple landscape image.
[Drawing 19] A traffic environment is drawing showing an example of a complicated landscape image.
[Drawing 20] It is the flow chart which shows the concrete operations sequence of the step ST 3 in a main routine.
[Drawing 21] It is the flow chart which shows the concrete operations sequence of the step ST 31 in a subroutine.
[Drawing 22] It is the flow chart which shows the concrete operations sequence of the step ST 32 in a subroutine.
[Drawing 23] It is drawing for explaining other technique of division of an image pick-up image.
[Drawing 24] It is drawing for explaining other technique of division of an image pick-up image.
[Drawing 25] It is drawing for explaining other technique of division of an image pick-up image.
[Drawing 26] It is drawing showing an example of division of middle of the screen.
[Drawing 27] When ten persons' driver is shown the image pick-up image of ten sheets, it is drawing which plotted the environmental recognition degree inputted by the driver.
[Drawing 28] It is drawing showing the recognition degree map in which the recognition degree determined by the index C1 and the index C2 is shown.
[Drawing 29] It is drawing showing the three-dimension vector space which consists of an index C1, an index C2, an index C1, and C2.
[Drawing 30] It is drawing explaining the condition of having prepared the 1st field presumed an environmental

recognition degree being low and the 2nd field presumed an environmental recognition degree being high in three-dimension vector space.

[Drawing 31] It is the block diagram showing the functional configuration of the microcomputer which presumes an environmental recognition degree using a neural network.

[Description of Notations]

1 Obstruction Alarm

10 Infrastructure Information Detecting Element

20 Obstruction Information Detecting Element

40 Environmental-Information Detecting Element

60 Obstruction Information Output Section

70 Microcomputer

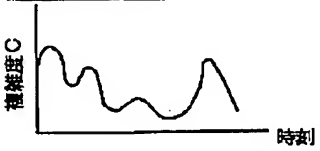
[Translation done.]

DRAWINGS

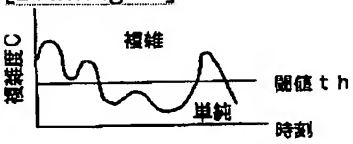
[Drawing 6]

	障害物	出現可能範囲
1	歩行者	現時点から半径1.0m
・	・	・
・	・	・
n	車	現時点から進行方向に10.0m
・	・	・
・	・	・

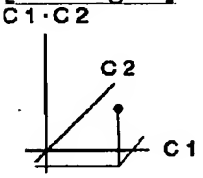
[Drawing 14]



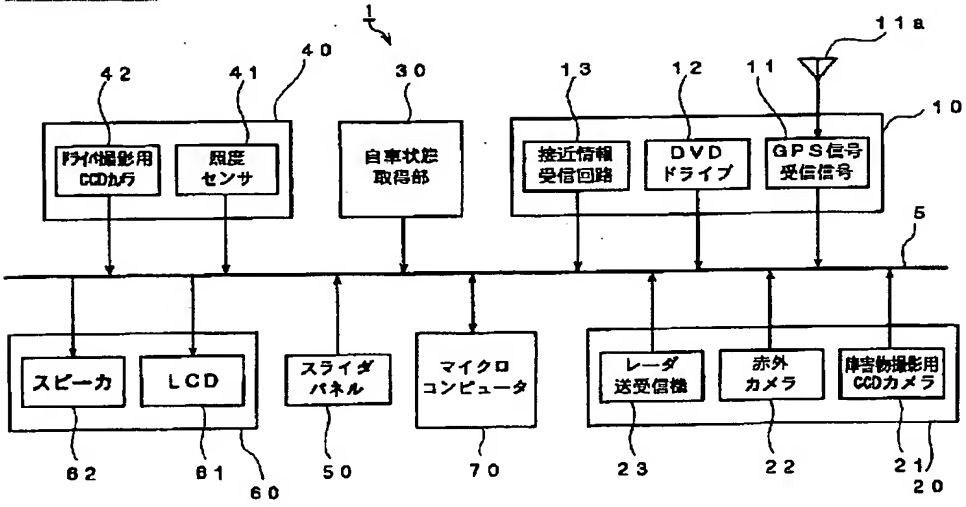
[Drawing 17]



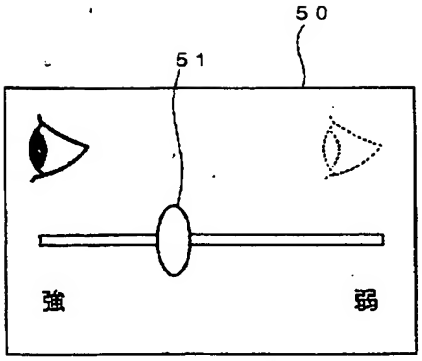
[Drawing 29]



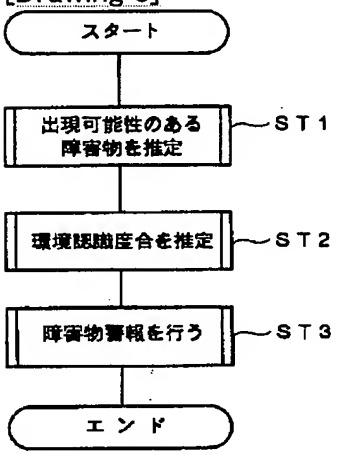
[Drawing 1]



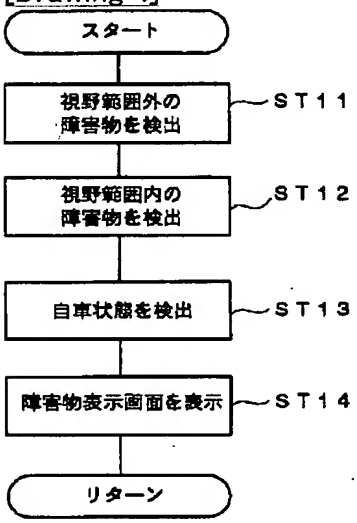
[Drawing 2]



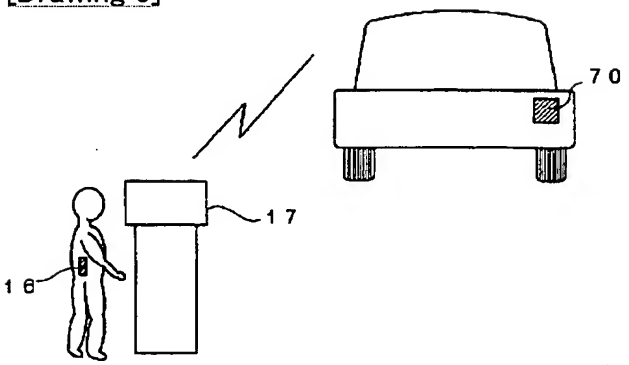
[Drawing 3]



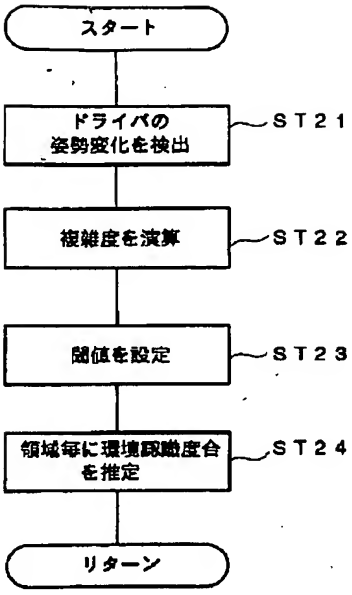
[Drawing 4]



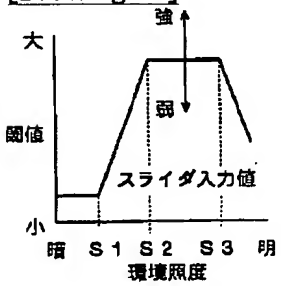
[Drawing 5]



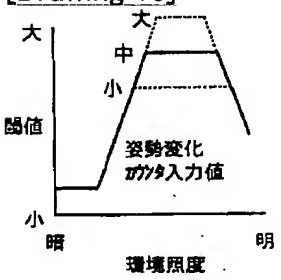
[Drawing 8]



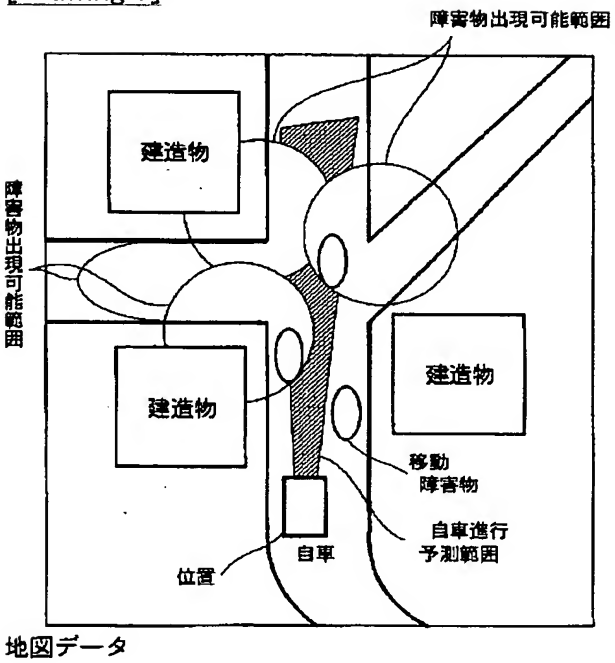
[Drawing 15]



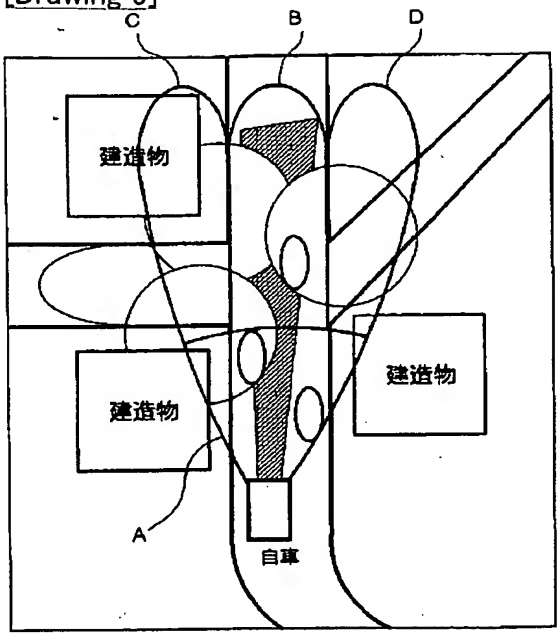
[Drawing 16]



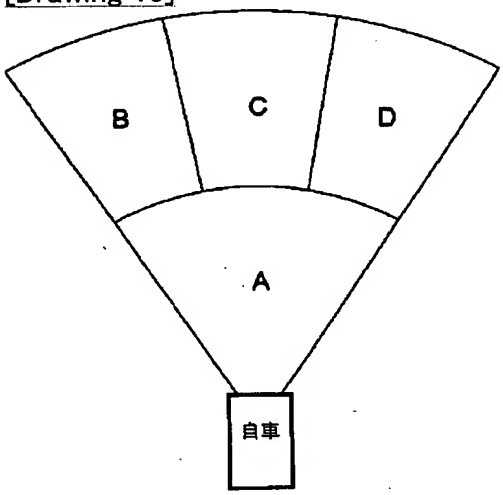
[Drawing 7]



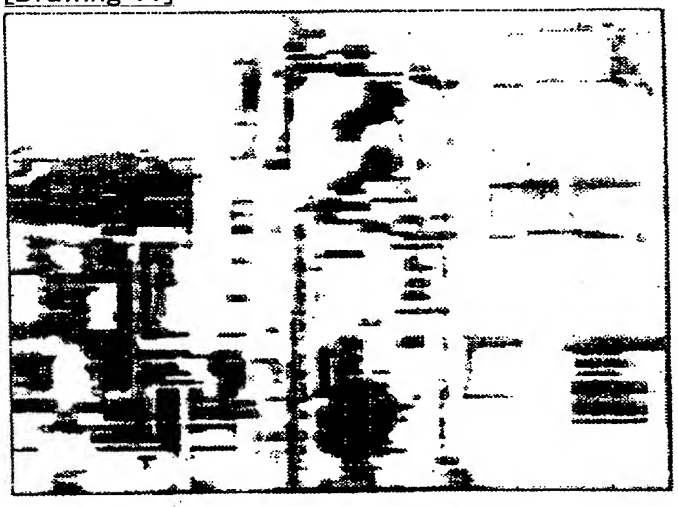
[Drawing 9]



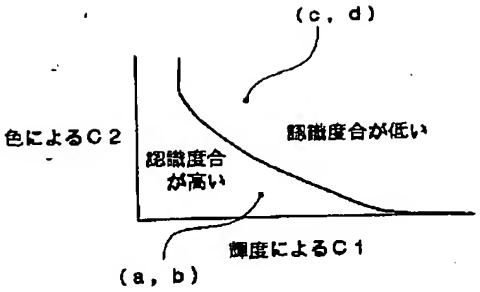
[Drawing 10]



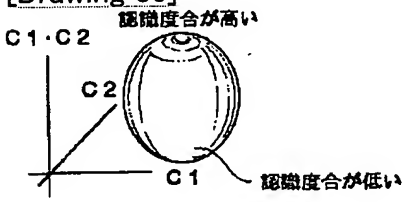
[Drawing 11]



[Drawing 28]



[Drawing 30]



[Drawing 12]

(A)

BK1

000	012	015	020	025	035	085	100
001	020	020	025	020	059	080	150
021	025	026	020	050	100	126	180
018	020	018	018	025	085	099	125
035	045	035	020	016	035	085	120
045	070	020	025	021	020	020	025
021	058	026	018	021	025	026	020
018	035	018	016	018	020	018	016

(B)

BK2 BK3

025	035	085	100
020	059	080	150
050	100	126	180
025	085	099	125

BK4 BK5

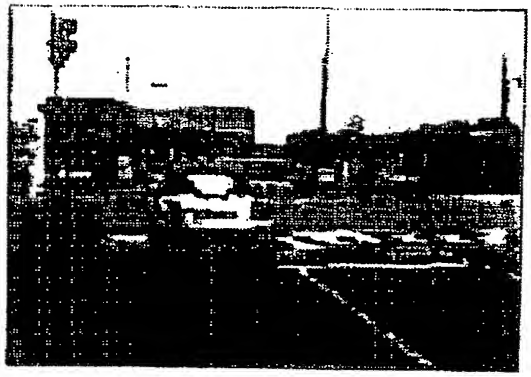
(C)

BK2

025	035	085	100
020	059	080	150
050	100	126	180
025	085	099	125

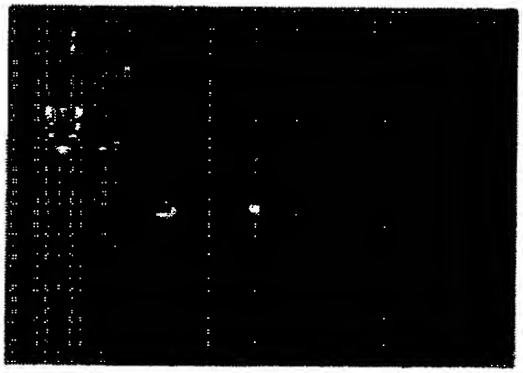
[Drawing 13]

(A)



(B)

(C)



(D)

1	1	0	0	0	0	0	0
1	1	0	1	0	0	0	0
1	1	1	1	0	0	0	0
0	1	1	0	1	0	0	0

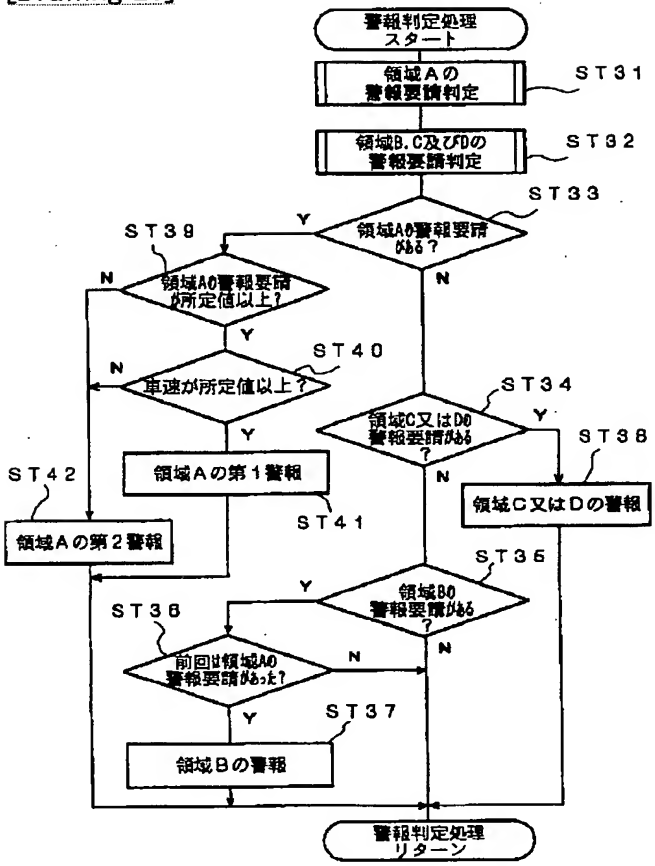
[Drawing 18]

単純な前方風景例

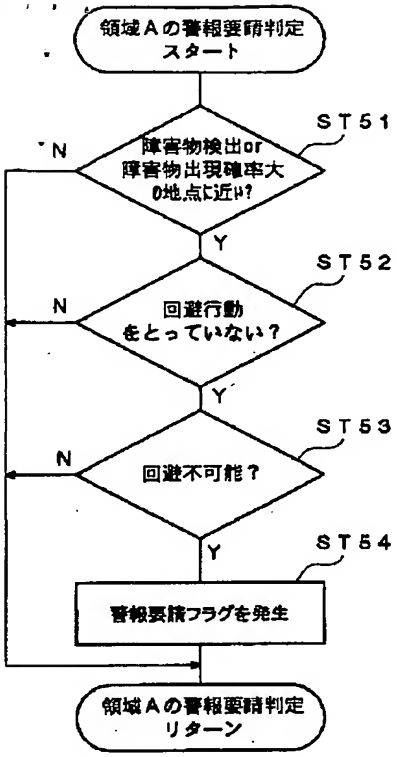
[Drawing 19]

複雑な前方風景例

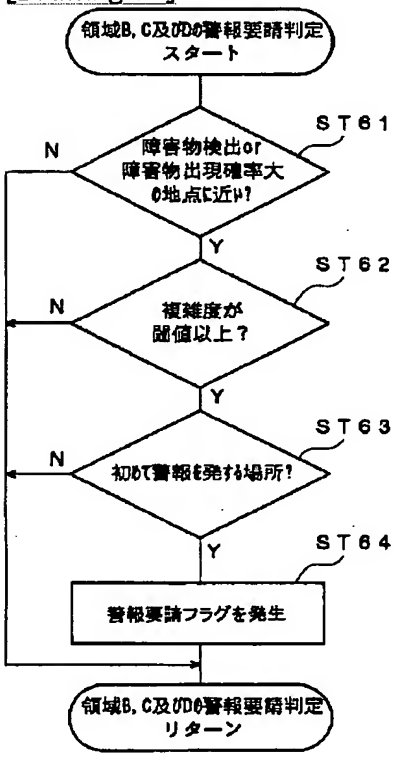
[Drawing 20]



[Drawing 21]

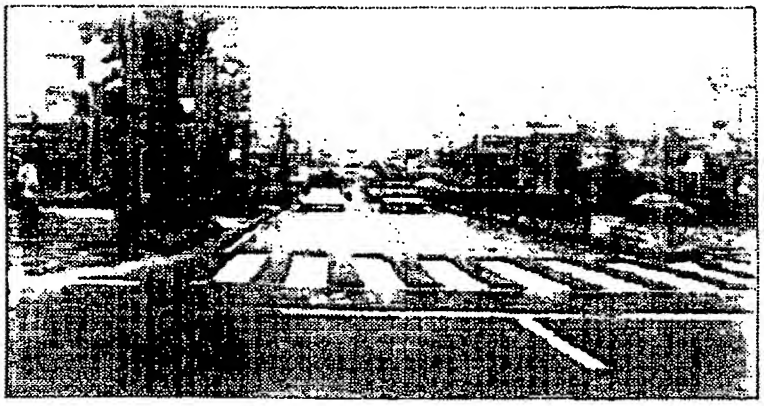


[Drawing 22]

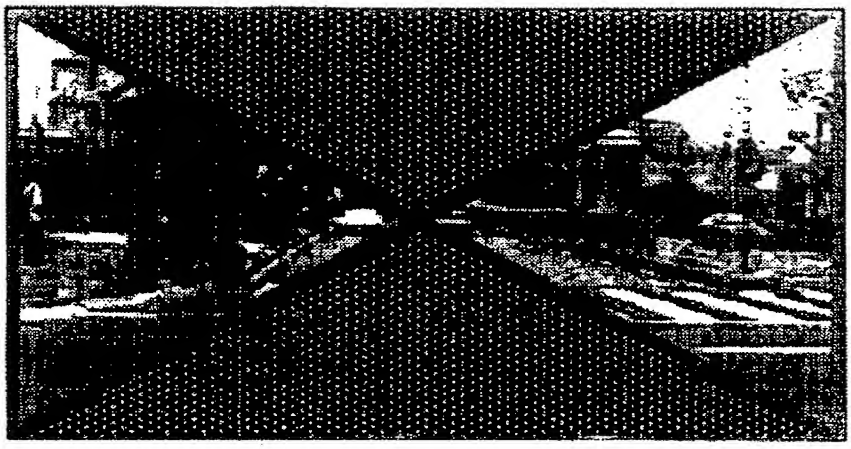


[Drawing 23]

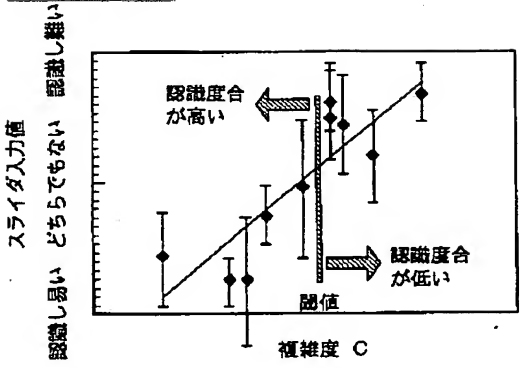
(A)



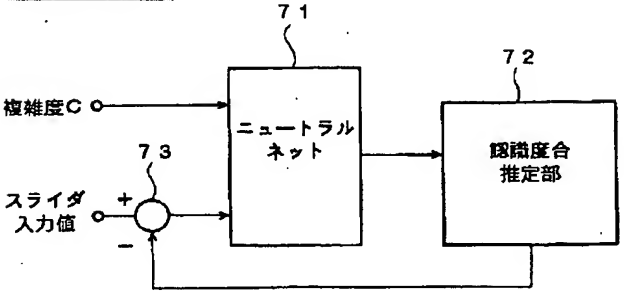
(B)



[Drawing 27]

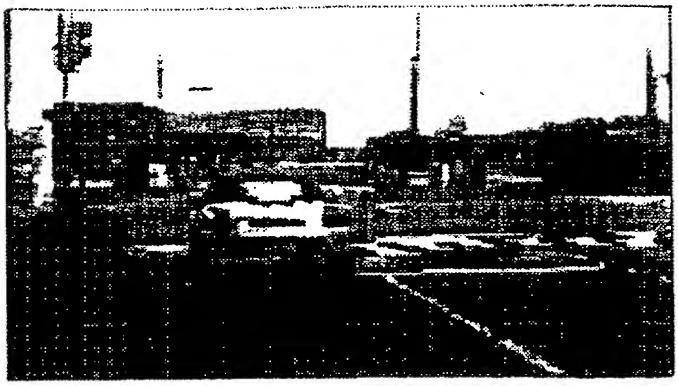


[Drawing 31]

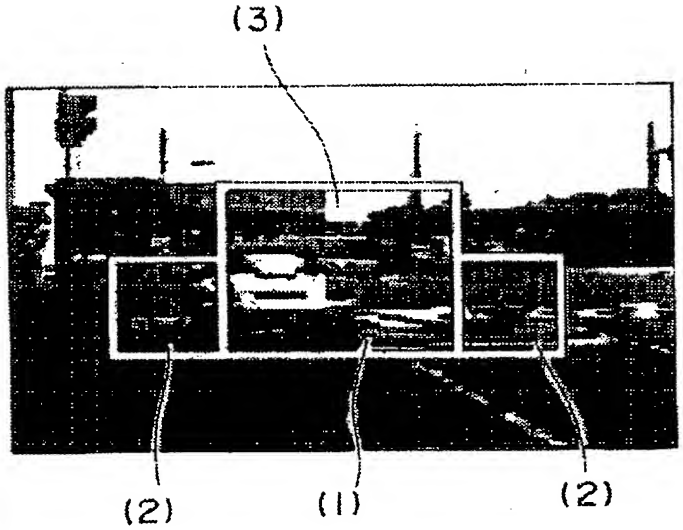


[Drawing 24]

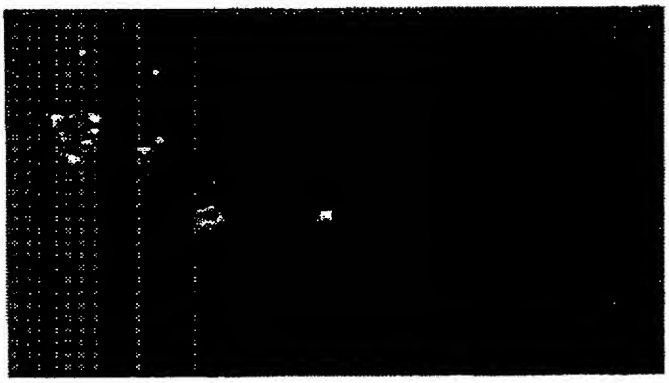
(A)



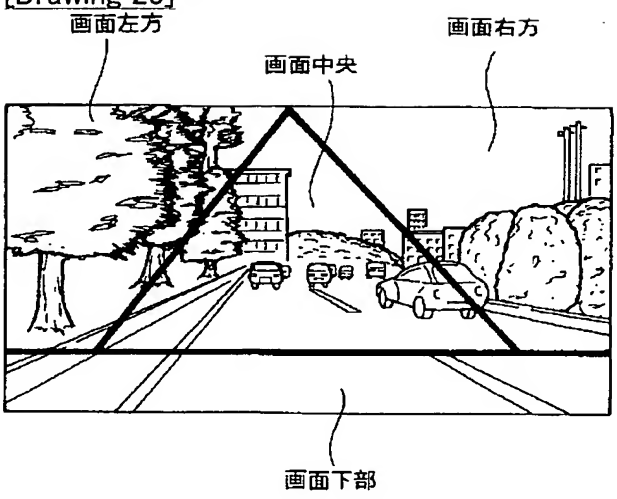
(B)



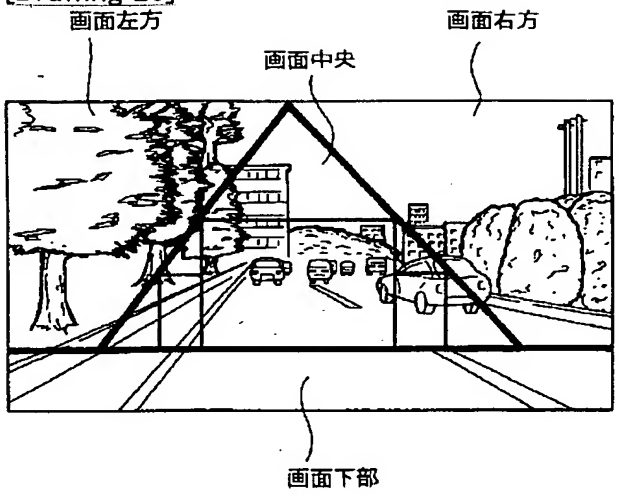
(C)



[Drawing 25]



[Drawing 26]



[Translation done.]

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Ｂ６０Ｒ	1/00		Ｂ６０Ｒ	1/00	Ａ　５Ｌ０９６
	21/00	６２４		21/00	６２４Ｃ
					６２４Ｄ
					６２４Ｅ

審査請求　未請求　請求項の数10　ＯＬ　（全 20 頁）　最終頁に続く

(21)出願番号　特願2001－258170(P2001－258170)

(22)出願日　平成13年８月28日(2001.8.28)

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最終頁に続く

(54)【発明の名称】　環境複雑度演算装置、環境認識度合推定装置及び障害物警報装置

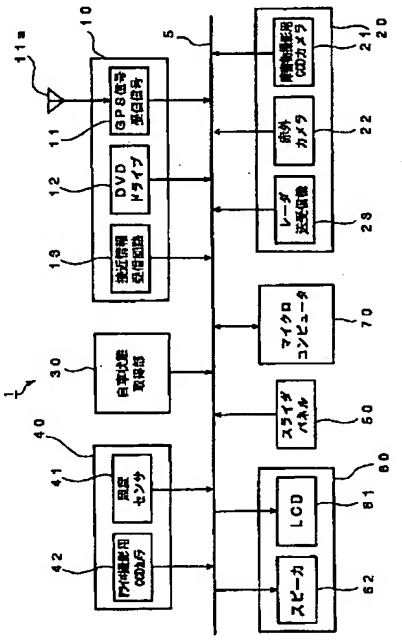
(57)【要約】

【課題】　ドライバに過剰な情報を提示することなく効率的かつ的確に障害物認識支援を行う。

【解決手段】　マイクロコンピュータ７０は、障害物撮影用ＣＣＤカメラ２１で得られた撮像画像を領域Ａから領域Ｄまでに分割し、領域Ｂ、領域Ｃ及び領域Ｄのそれぞれについて、次式に基づいて交通環境の複雑度Ｃを演算する。

$C=\alpha \cdot C1+\beta \cdot C2+\gamma \cdot C1 \cdot C2$

指標Ｃ１は輝度分割ブロックの総数、指標Ｃ２は赤色系分割ブロックの総数を示している。また、α、β、γは、重み付け係数であり、それぞれ所定の値をとる。



【特許請求の範囲】
【請求項１】　環境からの撮像光に基づいて撮像画像を生成する撮像手段と、
前記撮像手段で生成された撮像画像に含まれる輝度の変化の分布、前記撮像画像に含まれる赤色系画素の分布の少なくとも一方に基づいて、環境の複雑度を演算する複雑度演算手段と、
を備えた環境複雑度演算装置。
【請求項２】　前記複雑度演算手段は、
前記撮像手段で生成された撮像画像に輝度分割ブロックを設定し、
設定された輝度分割ブロック内において各画素の輝度値が均質であると判断されるまで、前記輝度分割ブロックを分割して新たな輝度分割ブロックを設定することを繰り返し、
前記撮像画像に対して、各画素の輝度値が均質になった輝度分割ブロックの数に基づいて環境の複雑度を演算することを特徴とする請求項１記載の環境複雑度演算装置。
【請求項３】　前記複雑度演算手段は、
前記撮像手段で生成された撮像画像に赤色系分割ブロックを設定し、
設定された赤色系分割ブロックが所定の赤色系画素のみで構成されるまで、前記赤色系分割ブロックを分割して新たな赤色系分割ブロックを設定することを繰り返し、
前記撮像画像に対して、前記所定の赤色系画素のみで構成される赤色系分割ブロックの数に基づいて環境の複雑度を演算することを特徴とする請求項１記載の環境複雑度演算装置。
【請求項４】　前記複雑度演算手段は、
前記撮像手段で生成された撮像画像に輝度分割ブロックを設定し、設定された輝度分割ブロック内において各画素の輝度値が均質であると判断されるまで、前記輝度分割ブロックを分割して新たな輝度分割ブロックを設定することを繰り返し、前記撮像画像に対して、各画素の輝度値が均質になった輝度分割ブロックの数を演算し、
前記撮像手段で生成された撮像画像に赤色系分割ブロックを設定し、設定された赤色系分割ブロックが所定の赤色系画素のみで構成されるまで、前記赤色系分割ブロックを分割して新たな赤色系分割ブロックを設定することを繰り返し、前記撮像画像に対して、前記所定の赤色系画素のみで構成される赤色系分割ブロックの数を演算し、
前記輝度分割ブロックの数と、赤色系分割ブロックの数と、に基づいて環境の複雑度を演算することを特徴とする請求項１記載の環境複雑度演算装置。
【請求項５】　請求項１から４のいずれか１項記載の複雑度演算装置と、
前記複雑度演算装置で演算された複雑度に基づいて、環境の認識度合を推定する環境認識度合推定手段と、
を備えた環境認識度合推定装置。
【請求項６】　前記環境認識度合推定手段は、前記複雑度演算装置で演算された複雑度が閾値以上であるときは環境の認識度合が低いと推定し、前記複雑度演算装置で演算された複雑度が閾値より小さいときは環境の認識度合が高いと推定することを特徴とする請求項５記載の環境認識度合推定装置。
【請求項７】　環境の照度を検出する照度検出手段を更に備え、
前記環境認識度合推定手段は、前記照度検出手段により検出された照度に対応する前記閾値を設定し、設定された閾値を用いて環境の認識度合を推定することを特徴とする請求項５または６記載の環境認識度合推定装置。
【請求項８】　観察者の姿勢変化を検出する姿勢変化検出手段を更に備え、
前記環境認識度合推定手段は、前記姿勢変化検出手段で検出された観察者の姿勢変化が大きくなるに従って閾値を大きく設定し、前記姿勢変化検出手段で検出された観察者の姿勢変化が小さくなるに従って閾値を小さく設定し、設定された閾値を用いて環境の認識度合を推定することを特徴とする請求項５から７のいずれか１項記載の環境認識度合推定装置。
【請求項９】　所定領域毎に環境の認識度合を推定する請求項５から８のいずれか１項記載の環境認識度合推定装置と、
障害物の位置を検出する障害物位置検出手段と、
前記障害物検出手段で検出された障害物の位置を含む所定領域が、前記環境認識度合推定手段によって環境の認識度合が低いと推定されたときに、前記障害物に関する警報を行う警報手段と、
を備えた障害物警報装置。
【請求項１０】　前記環境認識度合推定装置は、撮像画像の下部を除く領域を複数の推定領域に分割し、分割された推定領域毎に環境の認識度合を推定し、
前記警報手段は、前記障害物位置検出手段により検出された障害物の位置が前記推定領域のいずれにあり、かつ、当該推定領域の環境の認識度合が前記環境認識度合推定手段によって低いと推定されたときに、優先度の高い推定領域に存在する障害物に関する警報を行うことを特徴とする請求項９記載の障害物警報装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、環境複雑度演算装置、環境認識度合推定装置及び障害物警報装置に係り、特に、車両周囲の交通環境に応じてドライバの障害物認識支援を行う環境複雑度演算装置、環境認識度合推定装置及び障害物警報装置に関する。
【０００２】
【従来の技術及び発明が解決しようとする課題】車両の運転において、車両の直進時では左右からの飛び出しの

確認をすることや、車両の右左折時では進行方向に対して左右の横断物の確認を行うことは、事故を防止する上で重要である。左右から飛び出したり横断する移動体は、例えば、歩行者、２輪車、４輪車などの種々のものが考えられる。

【０００３】特開平３－２６０８１３号公報では、このような移動体を検出する環境認識装置が提案されている。環境認識装置は、明度情報の差分や閉区間領域を抽出することで輪郭情報を得て、輪郭情報から移動物体を認識している。しかし、車両を取り巻く照明条件は刻々と変わり、また外乱光などの影響があるため、輪郭を完全にかつ鮮明に抽出できることは少ない。したがって、上記環境認識装置は、輪郭情報のみを用いて画像認識を行うので、情報量の少なさから環境変化への対応が弱い。特に、車両に搭載されて障害物等を検出する場合では、上述した影響を大きく受けるので、最適に移動体を検出することができるとは言いがたい。また、明度情報から直接閉区間を抽出する処理は、影や外乱光などの影響を受けやすく、外乱光によって変化した明度が直接に重心や面積の変化に影響を与えるため、困難である。

【０００４】このほか、テンプレートマッチングやテクスチャーマッチングなど輪郭情報に内部情報を加えた検出手法も提案されている。しかし、処理時間がかかってしまったり、テンプレートに関する膨大な情報を予め用意する手間がかかってしまうなどの問題がある。

【０００５】こうした背景の下、例えば近年、画像情報を圧縮する技術から派生して、カメラの撮像情報を明度データの分布ととらえる技術が提案されている。

【０００６】特開平１１－１４２１６８号公報では、多変量解析の１つである主成分分析などを行い、撮像情報を正規化主成分特徴量で張られた情報空間に写像し、情報空間内でのデータの挙動を解析することによって画像認識する手法を改良した技術が提案されている。この技術は、正規化主成分特徴量を車両運動情報、操作情報を用いてよりロバストな環境認識を行うものである。また、特開２０００－１９２５９号公報では、可視光線映像情報と可視光以外の赤外線映像情報とを用いて物体を認識する技術が提案されている。

【０００７】しかし、これらの技術は、例えばガードレールや停止車輌等の物体の認識を妨げる要因が多く存在する場合、移動体を認識することが困難である。例えば、車両が通行する路面上以外の歩道や交差点における歩行者、自転車の待機場所や停止車輌間から飛び出してきた歩行者を認識することができない問題がある。

【０００８】これに対して、例えば特開平１１－３０１３４３号では、障害物そのものだけでなく、カメラ（可視光、赤外）を用いた、環境（道路形状）認識により移動障害物の出現確率を予測する車両用照明装置が提案されている。また、特開平１１－２３２５６９号では、交差点等に歩行者が近づいたか否かを車輌側へ発信する装置をもつ歩行者警報システムが提案されている。さらに、特開平６－１４４１２９号公報では、移動障害物を積極的に認識することなく、同一の注意すべき状態に対して複数用意されていた注意項目をランダムに１つ選択して運転手に報知することで注意喚起を図る注意喚起アシスト装置が提案されている。

【０００９】このように、移動障害物の自動認識、移動物体の出現確率を考慮したもの、あるいは歩行者の接近警告などを行うことによって、ドライバに対して障害物認識支援をする移動障害物認識支援が提案されている。

【００１０】しかし、最終的に移動障害物を認識するのはドライバ自身である。そのドライバの視覚認知、認知特性を考慮しなければ、大量の情報をドライバに提示しすぎたために、かえってドライバーを混乱させる可能性がある。また、注意項目を場所にあわせてランダムに提示する方法は、情報提示量は少ないものの非効率である。

【００１１】本発明は、上述した課題を解決するために提案されたものであり、ドライバに過剰な情報を提示することなく効率的かつ的確に障害物認識支援を行うことができる環境複雑度演算装置、環境認識度合推定装置及び障害物警報装置を提供することを目的とする。

【００１２】

【課題を解決するための手段】請求項１記載の発明は、環境からの撮像光に基づいて撮像画像を生成する撮像手段と、前記撮像手段で生成された撮像画像に含まれる輝度の変化の分布、前記撮像画像に含まれる赤色系画素の分布の少なくとも一方に基づいて、環境の複雑度を演算する複雑度演算手段と、を備えている。

【００１３】請求項１記載の発明では、撮像手段は、例えば車両前席から正面の交通環境を撮像するように設置されているのが好ましい。複雑度演算手段は、撮像画像に含まれる輝度変化の分布から、画像の複雑さを示す空間周波数を求めることができる。また、複雑度演算手段は、撮像画像に含まれる赤色系画素の分布から画像の複雑度を求めることができる。

【００１４】請求項２記載の発明は、請求項１記載の発明において、前記複雑度演算手段は、前記撮像手段で生成された撮像画像に輝度分割ブロックを設定し、設定された輝度分割ブロック内において各画素の輝度値が均質であると判断されるまで、前記輝度分割ブロックを分割して新たな輝度分割ブロックを設定することを繰り返し、前記撮像画像に対して、各画素の輝度値が均質になった輝度分割ブロックの数に基づいて環境の複雑度を演算することを特徴とする。

【００１５】請求項２記載の発明では、複雑度演算手段は、撮像画像に対して輝度分割ブロックを設定する。最初に設定される輝度分割ブロックは、複雑度を演算する領域を示している。そして、輝度分割ブロック内において、各画素の輝度値が均質であると判断されるまで、前

記輝度分割ブロックを分割し、分割された輝度分割ブロックを新たな輝度分割ブロックとして設定し、この処理を繰り返す。ここで、各画素の輝度値が均質であるとは、各画素の輝度値が一致する場合に限らず、輝度値の最大値と輝度値の最小値の差が所定値以下であればよい。すなわち、各画素の輝度値のばらつきが所定値以下になっていればよい。

【００１６】そして、すべての輝度分割領域内の各画素の輝度値が均質であると判断されると、これらのすべての輝度分割ブロックの数を環境の複雑度として求める。このような輝度分割ブロックの数は空間周波数に対応している。すなわち、総数が多いと高周波成分が多く、撮像画像が複雑である。また、総数が少ないと高周波成分が少なく、撮像画像は単純である。このように、輝度分割ブロックの数を求めることで、環境の複雑度を求めることができる。

【００１７】請求項３記載の発明は、請求項１記載の発明において、前記複雑度演算手段は、前記撮像手段で生成された撮像画像に赤色系分割ブロックを設定し、設定された赤色系分割ブロックが所定の赤色系画素のみで構成されるまで、前記赤色系分割ブロックを分割して新たな赤色系分割ブロックを設定することを繰り返し、前記撮像画像に対して、前記所定の赤色系画素のみで構成される赤色系分割ブロックの数に基づいて環境の複雑度を演算することを特徴とする。

【００１８】請求項３記載の発明では、複雑度演算手段は、撮像画像に対して赤色系分割ブロックを設定する。最初に設定される赤色系分割ブロックは、複雑度を演算する領域を示している。赤色系分割ブロックが所定の赤色系画素のみで構成されるまで、当該赤色系分割ブロックを分割する。そして、分割された赤色系分割ブロックを新たな赤色系分割ブロックとして設定し、この処理を繰り返す。すべての赤色系分割ブロックが所定の赤色系画素のみで構成されると、これらのすべての赤色系分割ブロックの数を環境の複雑度として求める。赤色は緑色に比べて誘目性が高い特性があり、赤色系分割ブロックの数は画像の複雑さを示している。したがって、上記赤色系分割ブロックの数を演算することで、環境の複雑度を求めることができる。

【００１９】請求項４記載の発明は、請求項１記載の発明において、前記複雑度演算手段は、前記撮像手段で生成された撮像画像に輝度分割ブロックを設定し、設定された輝度分割ブロック内において各画素の輝度値が均質であると判断されるまで、前記輝度分割ブロックを分割して新たな輝度分割ブロックを設定することを繰り返し、前記撮像画像に対して、各画素の輝度値が均質になった輝度分割ブロックの数を演算し、前記撮像手段で生成された撮像画像に赤色系分割ブロックを設定し、設定された赤色系分割ブロックが所定の赤色系画素のみで構成されるまで、前記赤色系分割ブロックを分割して新たな赤色系分割ブロックを設定することを繰り返し、前記撮像画像に対して、前記所定の赤色系画素のみで構成される赤色系分割ブロックの数を演算し、前記輝度分割ブロックの数と、赤色系分割ブロックの数と、に基づいて環境の複雑度を演算することを特徴とする。

【００２０】請求項４記載の発明では、複雑度演算手段は、請求項２記載の発明と同様にして輝度分割ブロックの数を求め、さらに、請求項３記載の発明と同様にして赤色系分割ブロックの数を求め、これらの総数に基づいて環境の複雑度を求める。環境の複雑度としては、輝度分割ブロックの数、赤色系分割ブロックの数、輝度分割ブロックの数と赤色系分割ブロックの数との積、にそれぞれ所定の重み付け係数を乗して、これらの総和を求めるのが好ましい。

【００２１】請求項５記載の発明は、請求項１から４のいずれか１項記載の複雑度演算装置と、前記複雑度演算装置で演算された複雑度に基づいて、環境の認識度合を推定する環境認識度合推定手段と、を備えている。

【００２２】請求項５記載の発明では、複雑度演算装置で演算された複雑度は、環境の撮像画像の複雑さを示していることから、観察者の環境の認識度合を推定するためのパラメータとして用いられる。すなわち、環境認識度合推定手段は、上記複雑度に基づいて環境の認識度合を推定することができる。

【００２３】請求項６記載の発明は、請求項５記載の発明において、前記環境認識度合推定手段は、前記複雑度演算装置で演算された複雑度が閾値以上であるときは環境の認識度合が低いと推定し、前記複雑度演算装置で演算された複雑度が閾値より小さいときは環境の認識度合が高いと推定することを特徴とする。

【００２４】請求項６記載の発明では、環境の認識度合の基準値となる閾値を設定する。すなわち、閾値は、環境が複雑と単純の中間を示す複雑度の値である。そこで、環境認識度合推定手段は、この閾値を用いることで、複雑度が閾値以上であるときは環境の認識度合が低いと推定し、複雑度が閾値より小さいときは環境の認識度合が高いと推定することができる。

【００２５】請求項７記載の発明は、請求項５または６記載の発明において、環境の照度を検出する照度検出手段を更に備え、前記環境認識度合推定手段は、前記照度検出手段により検出された照度に対応する前記閾値を設定し、設定された閾値を用いて環境の認識度合を推定することを特徴とする。

【００２６】請求項７記載の発明では、複雑度が一定であっても、車両外部が明るかったり暗くなったりすると、観察者は環境が複雑と感じたり単純と感じることがあることがある。そこで、このような照度の変化による環境の認識度合の変化を補正するため、照度に対応する閾値が予め記述された閾値テーブルを用いるのが好ましい。これにより、照度検出手段により照度が検出される

と、検出された照度に対応する閾値を設定することができる。そして、設定された閾値を用いて環境の認識度合を推定することができる。この結果、照度がどのような値であっても、環境の認識度合を正確に推定することができる。

【００２７】請求項８記載の発明は、請求項５から７のいずれか１項記載の発明において、観察者の姿勢変化を検出する姿勢変化検出手段を更に備え、前記環境認識度合推定手段は、前記姿勢変化検出手段で検出された観察者の姿勢変化が大きくなるに従って閾値を大きく設定し、前記姿勢変化検出手段で検出された観察者の姿勢変化が小さくなるに従って閾値を小さく設定し、設定された閾値を用いて環境の認識度合を推定することを特徴とする。

【００２８】請求項８記載の発明では、観察者は、姿勢変化が大きい場合には、環境を認識する度合が高い傾向にある。環境認識度合推定手段は、観察者の姿勢変化が大きくなるに従って閾値を大きく設定し、観察者の姿勢変化が小さくなるに従って閾値を小さく設定することで、観察者の実際の視覚特性に合致するように、環境の認識度合を正確に推定することができる。

【００２９】請求項９記載の発明は、所定領域毎に環境の認識度合を推定する請求項５から８のいずれか１項記載の環境認識度合推定装置と、障害物の位置を検出する障害物位置検出手段と、前記障害物検出手段で検出された障害物の位置を含む所定領域が、前記環境認識度合推定手段によって環境の認識度合が低いと推定されたときに、前記障害物に関する警報を行う警報手段と、を備えている。

【００３０】請求項９記載の発明では、障害物位置検出手段は、障害物の位置を検出する。このとき、環境認識度合推定装置は、障害物が検出された位置を含む所定領域の環境の認識度合を推定する。ここで、環境の認識度合が高い場合、観察者は、障害物位置検出手段によって検出された障害物を十分認識することができる。一方、環境の認識度合が低い場合、観察者は、障害物位置検出手段によって検出された障害物を認識することができない可能性がある。そこで、警報手段は、障害物の位置を含む所定領域が環境の認識度合が低いと推定されたときに、障害物に関する警報を行う。これにより、観察者は、環境の認識度合が低い領域に障害物がある場合でも、障害物があることを事前に認識して、事故を回避することができる。なお、警報手段は、画像又は音声を出力することによって、観察者に注意を喚起させることができるまた、警報手段は、障害物の位置を含む所定領域が環境の認識度合が高いと推定されたときに、障害物に関する警報は行わない。これにより、観察者は、環境の認識度合が高い領域に障害物がある場合では、その障害物を認識することができるので、余計な警報によって煩わしさを受けることがない。

【００３１】請求項１０記載の発明は、請求項９記載の発明において、前記環境認識度合推定装置は、撮像画像の下部を除く領域を複数の推定領域に分割し、分割された推定領域毎に環境の認識度合を推定し、前記警報手段は、前記障害物位置検出手段により検出された障害物の位置が前記推定領域のいずれにあり、かつ、当該推定領域の環境の認識度合が前記環境認識度合推定手段によって低いと推定されたときに、優先度の高い推定領域に存在する障害物に関する警報を行うことを特徴とする。

【００３２】請求項１０記載の発明では、環境認識度合推定装置は、撮像画像の下部を除く領域を複数の推定領域に分割し、分割された推定領域毎に環境の認識度合を推定する。つまり、撮像画像の下部については環境の認識度合を推定しない。その理由は、撮像画面の下部は、観察者直前の環境の画像を示しており、その環境の認識の度合を推定する意味がないからである。

【００３３】警報手段は、前記障害物位置検出手段により検出された障害物の位置が前記推定領域のいずれにあり、かつ、当該推定領域の環境の認識度合が前記環境認識度合推定手段によって低いと推定されたかを判定する。ここでは、障害物が検出され、かつ環境の認識度合が低い推定領域をすべて選択する。そして、選択された指定領域のうち優先度の高い推定領域について、障害物が存在する旨の警報を行う。これにより、最も危険な領域を観察者に注意させることで大きな事故を回避することができると共に、あまり危険でない領域については観察者に報知しないことで観察者が情報過多になって混乱するのを防止することができる。

【００３４】

【発明の実施の形態】以下、本発明の好ましい実施の形態について図面を参照しながら詳細に説明する。

【００３５】［第１の実施の形態］本発明の第１の実施の形態は、例えば図１に示す構成の障害物警報装置１に適用することができる。障害物警報装置１は、車両外部のインフラからインフラ情報を検出するインフラ情報をインフラ情報検出部１０と、道路及びその周辺の障害物に関する情報を検出する障害物情報検出部２０と、自車両の動作状態を検出する自車状態検出部３０と、ドライバや車両外部の環境を検出する環境情報検出部４０と、ドライバの環境認識の度合を示す視覚特性を入力するためのスライダパネル５０と、障害物情報を出力する障害物情報出力部６０と、各部において検出された情報に基づいて全体の制御を行うマイクロコンピュータ７０と、を備えている。

【００３６】インフラ情報検出部１０は、ＧＰＳ（Ｇｌｏｂａｌ　ＰｏｓｉｔｉｏｎｉｎｇＳｙｓｔｅｍ）信号を受信するＧＰＳ受信回路１１と、ＤＶＤディスクに記録されている地図情報を読み出すＤＶＤドライブ１２と、接近情報を受信する接近情報受信回路１３と、を備えている。

【００３７】ＧＰＳ受信回路１１は、ＧＰＳアンテナ１１ａを介して、時刻及びＧＰＳ衛星の位置情報を有するＧＰＳ信号を受信し、データバス５を介してマイクロコンピュータ７０に供給する。ＤＶＤドライブ１２は、車両が現在走行している位置情報に基づいて、ＤＶＤディスクから地図情報を読み出し、データバス５を介して、マイクロコンピュータ７０に供給する。接近情報受信回路１３は、後述するデータキャリアリーダから送信された接近情報を受信し、データバス５を介して、マイクロコンピュータ７０に供給する。

【００３８】障害物情報検出部２０は、道路上や道路周囲の障害物を撮影するための障害物撮影用ＣＣＤカメラ２１と、道路上や道路周囲の障害物を赤外線により撮影するための赤外カメラ２２と、前方障害物を認識するためのレーダ送受信機２３と、を備えている。

【００３９】障害物撮影用ＣＣＤカメラ２１及び赤外カメラ２２は、車両前方方向の物体を撮像できるように設置されている。そして、障害物撮影用ＣＣＤカメラ２１及び赤外カメラ２２は、撮影した撮影画像を、データバス５を介してマイクロコンピュータ７０に供給する。レーダ送受信機２３は、前方障害物を認識するために、当該障害物に対してパルス状の光レーダを鋭く絞って２次元方向に送信すると共に、障害物によって反射された光レーダを受光する。なお、レーダ送受信機２３は、光レーダを送受信するもの限らず、電波レーダを送受信するものであってもよい。

【００４０】自車状態検出部３０は、例えば、車輪速センサ、操舵角センサ、スロットルバルブセンサ、マスタシリンダ油圧センサ、ヨーレートセンサ、前後加速度センサ、横加速度センサ等を備えている。そして、自車状態検出部３０は、車速、ハンドル操舵角度、アクセル操作量、ブレーキ操作量、ヨーレート、ロールレート、ピッチレート、前後加速度、横加速度、ウィンカ操作量を検出して、マイクロコンピュータ７０に供給する。

【００４１】環境情報検出部４０は、車両外部の照度を検出する照度センサ４１と、ドライバを撮影するドライバ撮影用ＣＣＤカメラ４２と、を備えている。ここでは、ドライバ撮影用ＣＣＤカメラ４２は１つだけ設けられているが、ドライバの姿勢変化を容易に検出できるように、ドライバの正面前方、右前方、左前方をそれぞれ撮像する３つのＣＣＤカメラを設けてもよい。

【００４２】スライダパネル５０は、外部環境の複雑さを示す視覚特性をドライバの主観に従って操作入力するためのものである。スライダパネル５０、図２に示すように、左右に移動可能なスライダ５１を有している。ドライバは、例えば、自分自身が交通環境を見落としがちである場合、つまり車両外部の交通環境を認識しにくいと判断する場合は、スライダ５１を「弱」の方向に操作する。また、ドライバは、交通環境をよく見ることができる場合、つまり車両外部の交通環境を認識しやすい場合はスライダ５１を「強」の方向に操作する。これにより、詳しくは後述するが、マイクロコンピュータ７０は、ドライバの現在の視覚特性を考慮して環境認識度合を推定することができる。

【００４３】障害物情報出力部６０は、画像により障害物情報を出力するＬＣＤ（Ｌｉｑｕｉｄ　Ｃｒｙｓｔａｌ　Ｄｉｓｐｌａｙ）６１と、音声により障害物情報を出力するスピーカ６２と、を備えている。

【００４４】マイクロコンピュータ７０は、図示されていないＣＰＵ（Ｃｅｎｔｒａｌ　Ｐｒｏｃｅｓｓｉｎｇ　Ｕｎｉｔ）、データのワークエリアであるＲＡＭ（Ｒａｎｄｏｍ　Ａｃｃｅｓｓ　Ｍｅｍｏｒｙ）、後述する各種のルーチン処理を実行するプログラムや出現範囲推定テーブルや閾値テーブルが記憶されているＲＯＭ（Ｒｅａｄ　Ｏｎｌｙ　Ｍｅｍｏｒｙ）により構成されている。マイクロコンピュータ７０は、各部からの情報に基づいて、出現可能性のある障害物を推定したり、ドライバの環境認識度合を推定したり、障害物情報の警報を行う。

【００４５】（メインルーチン）以上のように構成された障害物警報装置１において、マイクロコンピュータ７０は、図３に示すステップＳＴ１からステップＳＴ３までの処理を実行する。ここでは、最初にステップＳＴ１からステップＳＴ３までの処理を簡単に説明し、その後各処理の具体的なサブルーチンについて説明する。

【００４６】マイクロコンピュータ７０は、インフラ情報検出部１０で検出された情報に基づいて自車位置を検出すると共に、自車の進行方向に出現する可能性のある障害物を推定する（ステップＳＴ１）。そして、自車の進行方向の環境の撮像画像を分割し、分割された領域毎にドライバが認識しやすいかを示す環境認識度合を推定する（ステップＳＴ２）。最後に、マイクロコンピュータ７０は、出現可能性のある障害物情報と、所定の領域毎の環境認識度合とに基づき、必要に応じて画像又は音声によりドライバに対して障害物に関する警報を行う（ステップＳＴ３）。

【００４７】（ステップＳＴ１）ステップＳＴ１では、マイクロコンピュータ７０は、自車の進行方向に出現する可能性のある障害物を推定すべく、具体的には図４に示すステップＳＴ１１からステップＳＴ１４までの処理を実行する。

【００４８】ステップＳＴ１１では、マイクロコンピュータ７０は、自車の位置を検出すると共に、自車位置周辺であってドライバの視界範囲外の移動障害物を検出する。なお、ここでは、例えば以下に説明するようなインフラが用いられている。

【００４９】例えば図５に示すように、歩行者は、データキャリア１６が設けられた物品（例えば、携帯電話）を常時携帯している。また、２輪車や４輪車には、データキャリア１６が設けられている。データキャリア１６

は数種類の接近情報を出力することができ、歩行者、２輪車及び４輪車のデータキャリア１６はそれぞれ異なる接近情報を出力する。一方、見通しの悪い交差点や横断歩道には、接近情報を受信するデータキャリアリーダ１７が設置されている。データキャリアリーダ１７は、データキャリア１６が接近すると、接近情報を受信して、この接近情報を障害物警報装置１に送信する。

【００５０】障害物警報装置１のマイクロコンピュータ７０は、データキャリアリーダ１７から送信された接近情報を接近情報受信回路１３で受信すると、障害物の場所を特定することができ、さらにその障害物が歩行者、２輪車、４輪車のいずれであるかを認識することができる。

【００５１】そして、マイクロコンピュータ７０は、ＧＰＳ受信回路１１により受信されたＧＰＳ信号と、ＤＶＤドライブ１２から読み出された地図情報と、接近情報受信回路１３により受信された接近情報と、に基づいて自車の位置を検出すると共に、自車位置周辺であってドライバの視界範囲外の移動障害物を検出し、当該移動障害物の種別（人、２輪車、４輪車のいずれか）を認識する。

【００５２】さらに、マイクロコンピュータ７０は、図６に示す出現範囲推定テーブルを参照して、移動障害物の種別に基づいて、自車周辺の路上における移動障害物が出現する可能性のある範囲を推定する。例えば、マイクロコンピュータ７０は、移動障害物として４輪車を認識したときは、当該４輪車は現在の位置から進行方向に１０ｍの範囲内に出現する可能性があると推定する。また、移動障害物として歩行者を認識したときは、当該歩行者は現在位置から半径１ｍの範囲内に出現する可能性があると推定する。

【００５３】マイクロコンピュータ７０は、自車の進行方向軸及び進行方向軸に直交する軸からなる座標系（以下「自車周辺座標系」という。）を設定し、移動障害物の出現可能性範囲を自車周辺座標系に記述して、ステップＳＴ１２に移行する。

【００５４】ステップＳＴ１２では、マイクロコンピュータ７０は、ドライバの視界範囲内にある障害物を検出する。ここでは、マイクロコンピュータ７０は、障害物撮影用ＣＣＤカメラ２１及び赤外カメラ２２を駆動させ、障害物撮影用ＣＣＤカメラ２１及び赤外カメラ２２により生成された撮像画像を取得する。そして、各カメラにより生成された画像の差分を求めることで、安全上特に問題となる人間や車をそれ以外のものと十分にコントラストを付けた画像を得ることによって、移動障害物を検出する。

【００５５】また、マイクロコンピュータ７０は、レーダ送受信機２３による送信から受信までの光レーダの往復時間に基づいて、自車の前方障害物の距離画像を得て、前方障害物を認識する。マイクロコンピュータ７０は、このようにして認識された移動障害物を自車周辺座標系に記述して、ステップＳＴ１３に移行する。

【００５６】ステップＳＴ１３では、マイクロコンピュータ７０は、自車状態検出部３０からの情報に基づいて自車状態を検出する。ここでは、例えば特開平１１－３０１３４３号公報に記載されているように、マイクロコンピュータ７０は、車速、ハンドル操舵角度、アクセル操作量、ブレーキ操作量、ヨーレート、ロールレート、ピッチレート、前後加速度、横加速度及びウィンカ操作量を検出し、自車の進行方向を推定して、自車の進行方向の推定結果を自車周辺座標系に記述して、ステップＳＴ１４に移行する。

【００５７】ステップＳＴ１４では、マイクロコンピュータ７０は、ステップＳＴ１１からステップＳＴ１３までの処理によって得られた自車周辺座標系に対して、自車の進行予測範囲内に出現する可能性のある移動障害物の情報のみを残し、その他の情報を除去する。そして、マイクロコンピュータ７０は、自車周辺座標系に記述された移動障害物に関する情報を障害物表示画面としてＬＣＤ６１に表示させると、サブルーチンを抜けて図３に示したステップＳＴ２に移行する。

【００５８】ここで、障害物表示画面は、例えば図７に示すように、自車が走行している周囲の地図と、自車の現在位置と、自車の進行予測範囲と、移動障害物（人や車など）及びその出現可能範囲を表示している。障害物表示画面に表示された移動障害物の大きさは、当該移動障害物が出現する可能性のある範囲を示している。

【００５９】（ステップＳＴ２）ステップＳＴ２では、マイクロコンピュータ７０は、車両周囲環境をドライバが認識する度合を推定すべく、具体的には図８に示すステップＳＴ２１からステップＳＴ２４までの処理を実行する。

【００６０】ステップＳＴ２１では、マイクロコンピュータ７０は、環境情報検出部４０からの情報を用いてドライバの姿勢の変化を検出する。すなわち、マイクロコンピュータ７０は、ドライバ撮影用ＣＣＤカメラ４２からの撮像画像についてフレーム間毎に差分を求め、撮像画像の差分値をドライバの移動領域量として検出する。

【００６１】マイクロコンピュータ７０は、移動領域量が所定の閾値以上のときは「１」をカウントし、移動領域量が所定の閾値より小さいときはカウントを行わない。そして、例えば過去５分間のカウント値を求め、当該カウント値が閾値ＴＨ１未満のときは姿勢変化が「小」であると判定し、当該カウント値が閾値ＴＨ１以上であり閾値ＴＨ２（＞ＴＨ１）未満のときは姿勢変化が「中」であると判定し、当該カウント値が閾値ＴＨ２以上のときは姿勢変化が「大」であると判定する。また、マイクロコンピュータ７０は、照度センサ４１により検出された車両外部の照度を取得して、ステップＳＴ２２に移行する。

【００６２】ステップＳＴ２２では、マイクロコンピュータ７０は、図７に示した障害物表示画面の所定領域毎に、環境の複雑度Ｃを演算する。なお、ここにいう複雑度Ｃとは、ドライバの交通環境の認識度合を推定するために用いられるパラメータをいう。

【００６３】最初に、マイクロコンピュータ７０は、ステップＳＴ１で得られた障害物表示画面のうち、障害物及びその出現可能範囲のある領域を、距離・方向で４分割する。ここでは図９に示すように、障害物表示画面を領域Ａ，領域Ｂ，領域Ｃ及び領域Ｄに分割する。これにより、上記障害物表示画面は、自車の前方正面近距離の領域である領域Ａと、領域Ａに隣接し、かつ自車の前方正面遠距離の領域である領域Ｂと、領域Ａ及びＢに隣接し、かつ自車の前方左遠距離の領域である領域Ｃと、領域Ａ及びＢに隣接し、かつ自車の前方右遠距離の領域である領域Ｄと、を有している。なお、障害物表示画面領域Ａから領域Ｄは、模式的には図１０に示すように分割される。

【００６４】次に、マイクロコンピュータ７０は、領域Ｂ、領域Ｃ及び領域Ｄのそれぞれについて、次の式（１）に基づいて交通環境の複雑度Ｃを演算する。

【００６５】

【数１】

$$C = \alpha \cdot C1 + \beta \cdot C2 + \gamma \cdot C1C2 \quad \cdots\cdots (1)$$

【００６６】指標Ｃ１は輝度分割ブロックの数、指標Ｃ２は赤色系分割ブロックの数を示している。また、α、β、γは、重み付け係数であり、それぞれ所定の値をとる。

【００６７】ここで、指標Ｃ１の演算について説明する。なお、マイクロコンピュータ７０は、上述したように領域Ｂ、領域Ｃ及び領域Ｄについて指標Ｃ１を演算するが、ここでは、領域Ｂについて図１１に示す撮像画像を用いて指標Ｃ１を演算することについて説明する。

【００６８】マイクロコンピュータ７０は、障害物撮影用ＣＣＤカメラ２１を駆動させ、例えば図１１に示すような撮像画像を得る。そして、当該撮像画像全体を輝度分割ブロックとして設定する。

【００６９】マイクロコンピュータ７０は、設定された輝度分割ブロック内において各画素の輝度値の最大値と最小値の差を演算する。マイクロコンピュータ７０は、輝度値の最大値と最小値の差が所定の閾値以上であるかを判定し、上記差が所定の閾値を超えているときは輝度分割ブロックを４つに分割する。このとき、マイクロコンピュータ７０は、縦横ほぼ同じ画素数で構成されるように、かつ可能な限り大きくするように、輝度分割ブロックを分割するのが好ましい。

【００７０】撮像画像の輝度値が例えば図１２（Ａ）に示すようになっている場合、マイクロコンピュータ７０は、輝度値の最大値（１８０）と最小値（０００）の差を演算する。そして、輝度値の最大値と最小値の差（１８０）が閾値（例えば４０）以上であるかを判定し、ここでは上記差が閾値（４０）を超えているので、図１２（Ａ）に示すように輝度分割ブロックを４つに分割する。

【００７１】マイクロコンピュータ７０は、分割された各輝度分割ブロック内において各画素の輝度値の最大値と最小値の差が所定の閾値以下になるまで、前記輝度分割ブロックを４つに分割し、新たな輝度分割ブロックを設定することを繰り返す。

【００７２】例えば、図１２（Ａ）に示す輝度分割ブロックＢＫ１は４×４画素で構成され、輝度値の最大値は１８０、輝度値の最小値は２０である。マイクロコンピュータ７０は、輝度分割ブロックＢＫ１の輝度値の最大値と最小値の差（１６０）を求め、上記差が閾値（４０）以上であるので、図１２（Ｂ）に示すように、輝度分割ブロックＢＫ１を４つ（ＢＫ２，ＢＫ３，ＢＫ４，ＢＫ５）に分割する。

【００７３】そして、マイクロコンピュータ７０は、輝度分割ブロックＢＫ２の輝度値の最大値と最小値の差（３９）は閾値（４０）以上でないので、輝度分割ブロックＢＫ２に対しては分割を行わない。一方、輝度分割ブロックＢＫ３，ＢＫ４，ＢＫ５については、輝度値の最大値と最小値の差は閾値（４０）以上であるので、図１２（Ｃ）に示すように、各輝度分割ブロックＢＫを分割する。

【００７４】このような処理を経て、マイクロコンピュータ７０は、各画素の輝度値の最大値と最小値の差が所定の閾値（４０）以下になった輝度分割ブロックの数を示す指標Ｃ１を求める。これにより、マイクロコンピュータ７０は、輝度分割ブロックを構成する各画素の輝度値を均質にする。

【００７５】なお、指標Ｃ１は、各画素の輝度値の最大値と最小値の差が所定の閾値以下になった輝度分割ブロックの数に限定されるものではない。例えば、指標Ｃ１は、撮像画像の輝度値の分散値であってもよい。また、指標Ｃ１は、撮像画像の２次元高速フーリエ変換（ＦＦＴ：Ｆａｓｔ　Ｆｏｕｒｉｅｒ　Ｔｒａｎｓｆｏｒｍ）の高周波成分の総和であってもよい。

【００７６】また、マイクロコンピュータ７０は、図１２（Ｃ）に示すように、輝度分割ブロックＢＫが１×１画素になるまで分割したが、輝度分割ブロックＢＫを分割して予め定めた大きさ（例えば、４×４画素）になったときに、分割を終了してもよい。

【００７７】つぎに、指標Ｃ２の演算について説明する。なお、マイクロコンピュータ７０は、上述したように所定領域毎に赤色系分割ブロックの数を示すＣ２を演

算するが、ここでは、領域Bについて、図１３（A）に示す撮像画像を用いて指標Ｃ２を演算することについて説明する。

【００７８】マイクロコンピュータ７０は、障害物撮影用ＣＣＤカメラ２１を駆動させ、例えば図１３（A）に示すような撮像画像を得る。そして、当該撮像画像から明度０．３以上、彩度０．１以上を抽出して、例えば図１３（B）に示すような撮像画像を得る。さらに、マイクロコンピュータ７０は、０．１以下又は０．７５以上の色相を抽出すると、図１３（C）に示すような撮像画像を得る。

【００７９】マイクロコンピュータ７０は、図１３（C）に示すような撮像画像に対して、同一の赤色系分割ブロック内が赤色系画素のみで占めるようにブロック分割を繰り返し、図１３（D）に示すように、赤色系画素（１）又は赤色系画素以外の画素（０）で構成された赤色系分割ブロックを得る。そして、マイクロコンピュータ７０は、赤色系画素のみで構成された赤色系分割ブロックの数である指標Ｃ２を求める。

【００８０】マイクロコンピュータ７０は、求められた輝度分割ブロックの数を示す指標Ｃ１及び赤色系分割ブロックの数を示す指標Ｃ２を用いて、上述した式（１）に従って環境の複雑度Ｃを演算して、ステップＳＴ２３に移行する。なお、以上のようにして演算された複雑度Ｃの値は、例えば図１４に示すように、時刻によって変化する。

【００８１】なお、指標Ｃ２は、赤色系分割ブロックの数に限定されるものではなく、例えば、次のような値でもよい。

【００８２】マイクロコンピュータ７０は、所定の領域の撮像画像に対して、マンセル色票において色票が２．５ＲＰ，５ＲＰ，７．５ＲＰ，１０ＲＰ，２．５Ｒ，５Ｒ，７．５Ｒ，１０Ｒ，２．５ＹＲ，５ＹＲに属し、クロマ２以上、明度３以上の赤色系の画素のみを抽出してもよい。そして、同一の分割ブロック内が上記赤色系画素のみ、赤色系画素以外の画素のみで構成されるまで、上記分割ブロックを分割することを繰り返し、得られた分割ブロックの数を指標Ｃ２とすればよい。

【００８３】また、マイクロコンピュータ７０は、所定の領域の撮像画像に対して、マンセル色票において色票が２．５ＲＰ，５ＲＰ，７．５ＲＰ，１０ＲＰ，２．５Ｒ，５Ｒ，７．５Ｒ，１０Ｒ，２．５ＹＲ，５ＹＲに属し、クロマ２以上、明度３以上の赤色系の画素のみを抽出し、上記赤色系の画素の数を指標Ｃ２としてもよい。あるいは、撮像画像の中央から上述した各赤色系画素の距離の総和を指標Ｃ２としてもよい。

【００８４】ステップＳＴ２３では、マイクロコンピュータ７０は、環境認識度合を判定するための閾値ｔｈを設定する。閾値ｔｈは、車両外部の環境照度によって異なるように設定される。その理由は、複雑度Ｃの値が一定であっても、車両外部が明るかったり暗くなったりすると、ドライバは交通環境が複雑と感じたり単純と感じることがあるからである。

【００８５】マイクロコンピュータ７０には、例えば図１５に示すように、環境照度に対する閾値ｔｈを記述した閾値テーブルが記憶されている。図１５によると、閾値ｔｈは、環境照度がゼロからＳ１までの場合は最小値（一定）となり、環境照度がＳ１からＳ２まで大きくなるに従って一定の割合で大きくなる。そして、閾値ｔｈは、環境照度がＳ２からＳ３までの場合は最大値（一定）となり、環境照度がＳ３より大きくなるに従って一定の割合で小さくなる。なお、図１５に示す閾値テーブルは本実施の形態の一例であり、本発明はこれに限定されるものではない。

【００８６】そこで、マイクロコンピュータ７０は、上記閾値テーブルを参照して、照度センサ４１によって検出された環境照度に基づいて、閾値ｔｈを設定する。さらに、マイクロコンピュータ７０は、ドライバの操作入力値やドライバの姿勢変化に応じて、閾値ｔｈの最大値を再設定することができる。

【００８７】最初に、マイクロコンピュータ７０は、スライダパネル５０に設けられたスライダ５１の入力値に応じて、閾値ｔｈの最大値を設定する。例えば、ドライバがスライダ５１を「強」の方にスライドしている場合は、図１５に示すように、マイクロコンピュータ７０は閾値ｔｈの最大値を大きく設定する。逆に、ドライバがスライダ５１を「弱」の方にスライドしている場合は、マイクロコンピュータ７０は閾値ｔｈの最大値を小さく設定する。なお、スライダ５１が「強」と「弱」の中間にある場合は、マイクロコンピュータ７０は、環境照度に基づいて設定されたデフォルトの閾値ｔｈのままでよい。

【００８８】次に、マイクロコンピュータ７０は、ドライバの姿勢変化に応じて、閾値ｔｈの最大値を設定する。その理由は、ドライバは、頻繁に姿勢の変化がある場合では種々の環境を認識し易い傾向があり、姿勢の変化がない場合では環境を認識しにくい傾向があるからである。そこで、マイクロコンピュータ７０は、交通環境の認識のしやすさとドライバの姿勢変化の関係を考慮して、以下のように閾値ｔｈを設定する。

【００８９】マイクロコンピュータ７０は、例えば上述したステップＳＴ２１においてドライバの姿勢変化が「小」であると判定した場合、図１６に示すように、閾値ｔｈの最大値を小さく設定する。逆に、例えばステップＳＴ２１においてドライバの姿勢変化が「大」であると判定した場合は、閾値ｔｈの最大値を大きく設定する。なお、マイクロコンピュータ７０は、ドライバの姿勢変化が「中」であると判定した場合は、環境照度に基づいて設定されたデフォルトの閾値ｔｈのままでよい。

【００９０】このように、マイクロコンピュータ７０

は、環境照度に対応する閾値ｔｈが記述された閾値テーブルと、スライダパネル５０に設けられたスライダ５１の入力値と、更にドライバの姿勢変化と、に基づいて閾値ｔｈを設定すると、ステップＳＴ２４に移行する。

【００９１】ステップＳＴ２４では、マイクロコンピュータ７０は、図１７に示すように、ステップＳＴ２２で演算された複雑度Ｃと、ステップＳＴ２３で設定された閾値ｔｈとを比較する。そして、複雑度Ｃが閾値ｔｈを超えていなかったときは、環境は複雑でない、すなわち単純であると判定する。また、複雑度Ｃが閾値ｔｈを超えていたときは、環境は複雑であると判定する。

【００９２】マイクロコンピュータ７０は、障害物撮影用ＣＣＤカメラ２１で得られた撮像画像が例えば図１８に示すような前方風景の場合は、交通環境が「単純」であると判定し、例えば図１９に示すような前方風景の場合は、交通環境が「複雑」であると判定する。そして、サブルーチン処理を終了して、図３に示すステップＳＴ３に移行する。

【００９３】（ステップＳＴ３）ステップＳＴ３では、マイクロコンピュータ７０は、ドライバに対して障害物の警報を行う。ここでは、領域毎に警報要請フラグがあるかを判定し、優先順位の高いフラグを用いてドライバに所定の警報を行う。なお、ここにいう警報要請フラグとは、上記所定領域について障害物等の存在によりドライバに警報を行う必要があることを示すフラグをいう。そして、マイクロコンピュータ７０は、具体的には図２０に示すステップＳＴ３１からステップＳＴ４２までの処理を実行する。

【００９４】ステップＳＴ３１では、マイクロコンピュータ７０は、領域Ａの警報要請フラグを生成するか否かを判定する。ここでは、具体的には図２１に示すステップＳＴ５１からステップＳＴ５４までのサブルーチンを実行する。

【００９５】ステップＳＴ５１では、マイクロコンピュータ７０は、領域Ａにおいて障害物を検出したか、又は現在の自車位置が障害物出現範囲内にあるかを判定し、いずれか一方の条件を満たすときはステップＳＴ５２に移行し、いずれの条件も満たさないときはサブルーチン処理を終了する。

【００９６】ステップＳＴ５２では、マイクロコンピュータ７０は、上述したステップＳＴ１３で検出された自車状態に基づいて、障害物に対して自車が回避行動をとっているかを判定し、回避行動をとっているときはステップＳＴ５３に移行し、回避行動をとっていないときはサブルーチン処理を終了する。

【００９７】ステップＳＴ５３では、マイクロコンピュータ７０は、ステップＳＴ１において検出された障害物に関する情報及び自車状態に基づいて、自車が障害物を回避することが不可能であるかを判定する。そして、例えばドライバがブレーキペダルを踏んだり、ハンドルを操作して、障害物に対する回避行動をとっていたとしても、自車が障害物を回避することができないときはステップＳＴ５４に移行し、自車が障害物を回避することができるときはサブルーチン処理を終了する。

【００９８】ステップＳＴ５４では、マイクロコンピュータ７０は、領域Ａにおける警報要請フラグを発生してサブルーチン処理を終了する。マイクロコンピュータ７０は、このようなサブルーチン処理を終了すると、図２０に示すステップＳＴ３２に移行する。

【００９９】ステップＳＴ３２では、マイクロコンピュータ７０は、領域Ｂ，Ｃ及びＤのそれぞれに対して警報要請フラグを生成するか否かの判定を行う。具体的には図２２に示すステップＳＴ６１からステップＳＴ６４までのサブルーチン処理を実行する。なお、ここではいずれの領域でも同じ処理を行うので、領域Ｂの処理を例に挙げて説明する。

【０１００】ステップＳＴ６１では、マイクロコンピュータ７０は、領域Ｂにおいて障害物を検出したか、又は現在の自車位置が障害物出現範囲内にあるかを判定し、いずれか一方の条件を満たすときはステップＳＴ６２に移行し、いずれの条件も満たさないときはサブルーチン処理を終了する。

【０１０１】ステップＳＴ６２では、マイクロコンピュータ７０は、上述したステップＳＴ２において領域Ｂは複雑であると判定したか、すなわち、ステップＳＴ２において領域Ｂの複雑度Ｃが閾値ｔｈを超えたかを判定する。そして、領域Ｂの複雑度Ｃが閾値ｔｈを超えたときはステップＳＴ６３に移行し、閾値ｔｈを超えていないときはサブルーチン処理を終了する。

【０１０２】ステップＳＴ６３では、マイクロコンピュータ７０は、障害物又は障害物出現範囲の場所が初めて警報を発する場所であるかを判定し、初めて警報を発する場所であるときはステップＳＴ６４に移行し、初めて警報を発する場所でないときはサブルーチン処理を終了する。

【０１０３】ステップＳＴ６４では、マイクロコンピュータ７０は、領域Ｂにおける警報要請フラグを発生してサブルーチン処理を終了する。マイクロコンピュータ７０は、以上のようなサブルーチン処理を終了すると、図２０に示すステップＳＴ３３に移行する。

【０１０４】ステップＳＴ３３では、マイクロコンピュータ７０は、領域Ａの警報要請フラグがあるか否かを判定し、領域Ａの警報要請フラグがあったときはステップＳＴ３９に移行し、領域Ａの警報要請フラグがなかったときはステップＳＴ３４に移行する。

【０１０５】ステップＳＴ３４では、マイクロコンピュータ７０は、領域Ｃ又は領域Ｄの警報要請フラグがあるか否かを判定する。そして、各領域の少なくとも一方に警報要請フラグがあったときはステップＳＴ３８に移行し、各領域のいずれにも警報要請フラグがないときはス

テップＳＴ３５に移行する。

【０１０６】ステップＳＴ３５では、マイクロコンピュータ７０は、領域Ｂの警報要請フラグがあるか否かを判定し、領域Ｂの警報要請フラグがあったときはステップＳＴ３６に移行し、領域Ｂの警報要請フラグがなかったときはサブルーチン処理を終了する。

【０１０７】このように、マイクロコンピュータ７０は、ステップＳＴ３３からステップＳＴ３５の順に処理を実行することで、領域Ａ、領域Ｃ又は領域Ｄ、領域Ｂの順に優先順位を設定し、優先順位の高い領域から障害物の警報を行っている。

【０１０８】ステップＳＴ３６では、マイクロコンピュータ７０は、前回の判定処理で領域Ａの警報要請フラグがあったかを判定し、領域Ａの警報要請フラグがあったときはステップＳＴ３７に移行し、領域Ａの警報要請フラグがなかったときはサブルーチン処理を終了する。

【０１０９】ステップＳＴ３７では、マイクロコンピュータ７０は、ドライバに領域Ｂの警報を行う。マイクロコンピュータ７０は、ドライバに対する警報として、「前方障害物に注意してください。」、「交差点に近づきます。歩行者の飛び出しに注意してください。」などをＬＣＤ６１に表示させたり、音声によりスピーカ６２から出力させて、サブルーチン処理を終了する。

【０１１０】また、ステップＳＴ３４で領域Ｃ、領域Ｄの少なくとも一方の警報要請フラグがあったと判定して移行したときのステップＳＴ３８では、マイクロコンピュータ７０は、警報要請フラグのあった領域について、ドライバに対して警報を行う。警報要請の一例としては、ステップＳＴ３７と同様である。

【０１１１】一方、ステップＳＴ３３で領域Ａの警報要請フラグがあったと判定して移行したときのステップＳＴ３９では、領域Ａの警報要請フラグが所定数以上あるか否かを判定し、警報要請フラグが所定数以上あるときはステップＳＴ４０に移行し、警報要請フラグが所定数以上ないときはステップＳＴ４２に移行する。

【０１１２】ステップＳＴ４０では、マイクロコンピュータ７０は、自車状態検出部３０により検出された車速が所定値以上であるかを判定し、車速が所定値以上であるときはステップＳＴ４１に移行し、車速が所定値以上でないときはステップＳＴ４２に移行する。

【０１１３】ステップＳＴ４１では、マイクロコンピュータ７０は、ドライバに対して領域Ａにおける第１警報を行う。マイクロコンピュータ７０は、ドライバに対する第１警報として、例えば「衝突注意。減速してください。」などをＬＣＤ６１に表示させたり、音声によりスピーカ６２から出力させて、サブルーチン処理を終了する。

【０１１４】ステップＳＴ４２では、マイクロコンピュータ７０は、ドライバに対して領域Ａにおける第２警報を行う。マイクロコンピュータ７０は、ドライバに対する第２警報として、例えば「障害物を回避してください。」などをＬＣＤ６１に表示させたり、音声によりスピーカ６２から出力させて、サブルーチン処理を終了する。

【０１１５】マイクロコンピュータ７０は、ステップＳＴ３のサブルーチン処理を終了すると、ドライバに対する警報を終了する。このように、マイクロコンピュータ７０は、各領域の警報要請フラグに優先順位を設定して処理を行うことによって、ドライバに対する警報を最小限に抑制し、情報過多になってドライバが混乱することを防止することができる。

【０１１６】以上のように、第１の実施の形態に係る障害物警報装置１は、移動障害物を自動的に認識し、移動障害物の出現可能範囲を推定し、更に、移動障害物の出現場所において、ドライバの交通環境の認識度合を考慮することによって、ドライバを混乱させることなく、移動障害物をドライバに認識させることができる。また、障害物警報装置１は、ドライバに提示するべき情報量が多いときは、自車の車速を低下させるように促して、事故を未然に防止することができる。

【０１１７】障害物警報装置１は、図１０に示した領域Ａから領域Ｄのいずれにおいても障害物を検出した場合には、自車直前の領域Ａを最優先し、領域Ａに存在する障害物に対して警報を行う。これにより、障害物警報装置１は、直前に迫った危機を回避することができる。

【０１１８】［他の実施の形態］つぎに、本発明の他の実施の形態について説明する。なお、第１の実施の形態と重複する箇所については同一の符号を付し、詳細な説明は省略する。

【０１１９】（撮像画像の分割の態様）第１の実施の形態では、マイクロコンピュータ７０は、図１０に示すように、撮像領域を領域Ａから領域Ｄまでの４つに分割し、領域Ｂ、領域Ｃ及び領域Ｄにおいて指標Ｃ１及び指標Ｃ２を演算していた

これに対して、マイクロコンピュータ７０は、例えば図２３（Ａ）に示す撮像画像を、図２３（Ｂ）に示すように４つの領域に分割してもよい。つまり、マイクロコンピュータ７０は、長方形状の撮像画像を２つの対角線に沿って分割することによって、撮像画像を４つの領域に分割している。そして、第１の実施の形態と同様に、各領域について指標Ｃ１及び指標Ｃ２を演算すればよい。

【０１２０】また、マイクロコンピュータ７０は、例えば図２４（Ａ）に示す撮像画像を、図２４（Ｂ）に示すように、領域（１）、２つの領域（２）、領域（３）の４つの領域に分割してもよい。ここで、領域（１）は、自車の前方直前の車両を示す領域である。領域（２）は、領域（１）の両外側の領域である。領域（３）は、領域（１）及び領域（２）以外の領域である。

【０１２１】マイクロコンピュータ７０は、領域（１）については輝度分割ブロックを１×１画素まで分割し、

領域（２）については２×２画素まで分割し、領域（３）については２×２画素まで分割して、各領域で指標Ｃ１を演算することができる。さらに、マイクロコンピュータ７０は、各領域において赤色系分割ブロックを１×１画素まで分割して、図２４（Ｃ）に示す画像を得て、各領域で指標Ｃ２を演算することができる。

【０１２２】さらに、マイクロコンピュータ７０は、撮像画像を次のように分割することもできる。例えば図２５に示すように、撮像画像を「画面下部」、「画面中央」、「画面左方」、「画面右方」に分割してもよい。「画面下部」は、撮像画像の下側の縦方向約１／５から１／４までの長方形状の領域である。「画面中央」は、三角形状の領域であり、その三角形の一辺が「画面下部」に隣接し、その一辺の対角が撮像画面の上端に位置している。「画面左方」は、「画面下部」及び「画面中央」以外の領域のうち左側の台形状の領域である。「画面右方」は、「画面下部」及び「画面中央」以外の領域のうち右側の台形状の領域である。

【０１２３】画面中央については、図２６に示すように、さらに分割してもよい。

【０１２４】（閾値ｔｈの設定）マイクロコンピュータ７０は、第１の実施の形態のように、ドライバ個人によって操作されたスライダ５１の入力値に従って閾値ｔｈを設定する場合に限らず、例えば複数のドライバによって操作されたスライダ５１の各入力値に従って設定するようにしてもよい。

【０１２５】図２７は、１０名のドライバに１０枚の撮像画像を提示した場合に、ドライバによって入力された環境の認識度合をプロットした図である。マイクロコンピュータ７０は、例えばこれらの値の平均を演算することで妥当な閾値ｔｈを設定することができる。

【０１２６】（複雑度Ｃの他の演算手法）マイクロコンピュータ７０は、式（１）に従って複雑度Ｃを演算し、複雑度Ｃと閾値ｔｈとを比較することによって環境認識度合を推定していたが、本発明はこれに限定されるものではない。

【０１２７】マイクロコンピュータ７０は、例えば図２８に示すように、指標Ｃ１及び指標Ｃ２によって決定される認識度合を示す認識度合マップを記憶してもよい。このとき、マイクロコンピュータ７０は、第１の実施の形態と同様にして指標Ｃ１及び指標Ｃ２を演算し、上記認識度合マップを参照して環境の認識度合を推定すればよい。例えば、マイクロコンピュータ７０は、（Ｃ１，Ｃ２）＝（ａ，ｂ）のときは環境の認識度合が高いと判定し、（Ｃ１，Ｃ２）＝（ｃ，ｄ）のときは環境の認識度合が低いと判定することができる。

【０１２８】（３次元空間配置）マイクロコンピュータ７０は、撮像画像を予め所定領域に分割し、所定領域毎に、第１の実施の形態と同様に指標Ｃ１及び指標Ｃ２を演算し、さらに、指標Ｃ１・Ｃ２を演算する。そして、指標Ｃ１、指標Ｃ２、指標Ｃ１・Ｃ２を、図２９に示すように、３次元ベクトル空間に配置し、各画素上での移動ベクトルの値（大きさ、向き）を複雑度Ｃとして用いることもできる。

【０１２９】このとき、例えば図３０に示すように、３次元ベクトル空間内に、環境の認識度合が低いと推定される第１の領域と、環境の認識度合が高いと推定される第２の領域とを設けてもよい。マイクロコンピュータ７０は、上記３次元空間を用いて求められた複雑度Ｃが上記領域のいずれに属するかを判定し、複雑度Ｃが第１の領域にあるとドライバは環境認識の度合が低いと推定し、複雑度Ｃが第２の領域にあるとドライバは環境認識の度合が高いと推定することができる。

【０１３０】（ニューラルネット）マイクロコンピュータ７０は、ニューラルネットを用いて環境の認識度合を推定してもよい。図３１は、ニューラルネットを用いて環境の認識度合を推定するマイクロコンピュータ７０の機能的な構成を示すブロック図である。

【０１３１】マイクロコンピュータ７０は、更新可能なデータベースを有する変換関数からなるニューラルネット７１と、ドライバの環境の認識度合を推定する認識度合推定部７２と、入力値から推定値を減算する処理を行う演算器７３と、を備えている。なお、ニューラルネット７１の代わりに、統計的手法によって学習機能を備えたものであってもよい

演算器７３は、図２に示したスライダ５１の入力値から、認識度合推定部７２で推定された環境の認識度合の推定値を減算する。ニューラルネット７１は、演算器７３により減算された減算値と、複雑度Ｃとに基づいて逐次学習し、学習済みの複雑度Ｃを認識度合推定部７２に供給する。認識度合推定部７２は、ニューラルネット７１からの学習済みの複雑度Ｃを用いて、ドライバ毎に環境の認識度合を推定すればよい。

【０１３２】この結果、マイクロコンピュータ７０は、ドライバの実際の環境認識を考慮して逐次学習し、ドライバ個人の視覚特性に応じて、交通環境の認識度合を正確に推定することができる。

【０１３３】

【発明の効果】本発明に係る環境複雑度演算装置は、前記撮像手段で生成された撮像画像に含まれる輝度の変化の分布、前記撮像画像に含まれる赤色系画素の分布の少なくとも一方に基づいて、環境の複雑度を演算することによって、環境の認識のしにくさ、すなわち環境の複雑さを示す複雑度を求めることができる。

【０１３４】本発明に係る環境認識度合推定装置は、複雑度演算装置で演算された複雑度に基づいて環境の認識度合を推定することによって、観察者の環境の認識度合を客観的かつ正確に推定することができる。

【０１３５】本発明に係る障害物警報装置は、障害物の位置を検出し、検出された障害物の位置を含む所定領域

が環境の認識度合が低いと推定されたときに、前記障害物に関する警報を行うことによって、環境の認識度合の低い領域に障害物があるときに当該障害物の存在を観察者に警報することができる。一方、環境の認識度合の高い領域に障害物があるときに警報を行わないので、観察者が余計な警報によって煩わしさを受けることを防止することができる。

【図面の簡単な説明】

【図１】本発明の実施の形態に係る障害物警報装置の構成を示すブロック図である。

【図２】障害物警報装置に備えられたスライダパネルの構成を示す図である。

【図３】障害物警報装置に備えられたマイクロコンピュータの動作手順のメインルーチンを示すフローチャートである。

【図４】メインルーチンにおけるステップＳＴ１の具体的な動作手順を示すフローチャートである。

【図５】データキャリアとデータキャリアリーダの概要を説明するための図である。

【図６】マイクロコンピュータに記憶された出現範囲推定テーブルを示す図である。

【図７】ＬＣＤに表示される障害物表示画面を示す図である。

【図８】メインルーチンにおけるステップＳＴ２の具体的な動作手順を示すフローチャートである。

【図９】障害物表示画面を領域Ａから領域Ｄに分割した状態を説明する図である。

【図１０】障害物表示画面を模式的に領域Ａから領域Ｄに分割した状態を説明する図である。

【図１１】領域Ｂで指標Ｃ１を演算するときの撮像画像の一例を示す図である。

【図１２】撮像画像の輝度値の一例を示す図である。

【図１３】撮像画像の一例を示す図である。

【図１４】複雑度Ｃが時刻によって変化する状態を説明する図である。

【図１５】環境照度に対する閾値が記述された閾値テーブルを示す図である。

【図１６】ドライバの姿勢変化に応じて閾値ｔｈが変化する状態を説明する図である。

【図１７】複雑度Ｃと閾値ｔｈとを比較して環境の認識度合を推定するための図である。

【図１８】交通環境が単純である風景画像の一例を示す図である。

【図１９】交通環境が複雑である風景画像の一例を示す図である。

【図２０】メインルーチンにおけるステップＳＴ３の具体的な動作手順を示すフローチャートである。

【図２１】サブルーチンにおけるステップＳＴ３１の具体的な動作手順を示すフローチャートである。

【図２２】サブルーチンにおけるステップＳＴ３２の具体的な動作手順を示すフローチャートである。

【図２３】撮像画像の分割の他の手法を説明するための図である。

【図２４】撮像画像の分割の他の手法を説明するための図である。

【図２５】撮像画像の分割の他の手法を説明するための図である。

【図２６】画面中央の分割の一例を示す図である。

【図２７】１０名のドライバに１０枚の撮像画像を提示した場合に、ドライバによって入力された環境の認識度合をプロットした図である。

【図２８】指標Ｃ１及び指標Ｃ２によって決定される認識度合を示す認識度合マップを示す図である。

【図２９】指標Ｃ１、指標Ｃ２、指標Ｃ１・Ｃ２からなる３次元ベクトル空間を示す図である。

【図３０】３次元ベクトル空間内に、環境の認識度合が低いと推定される第１の領域と、環境の認識度合が高いと推定される第２の領域とを設けた状態を説明する図である。

【図３１】ニューラルネットを用いて環境の認識度合を推定するマイクロコンピュータの機能的な構成を示すブロック図である。

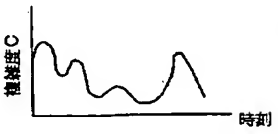
【符号の説明】

１　障害物警報装置
１０　インフラ情報検出部
２０　障害物情報検出部
４０　環境情報検出部
６０　障害物情報出力部
７０　マイクロコンピュータ

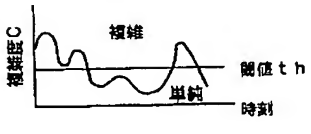
【図６】

	障害物	出現可能範囲
1	歩行者	現時点から半径1.0m
・	・	・
・	・	・
n	車	現時点から進行方向に10.0m
・	・	・
・	・	・

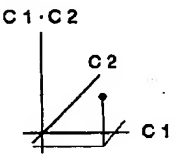
【図１４】



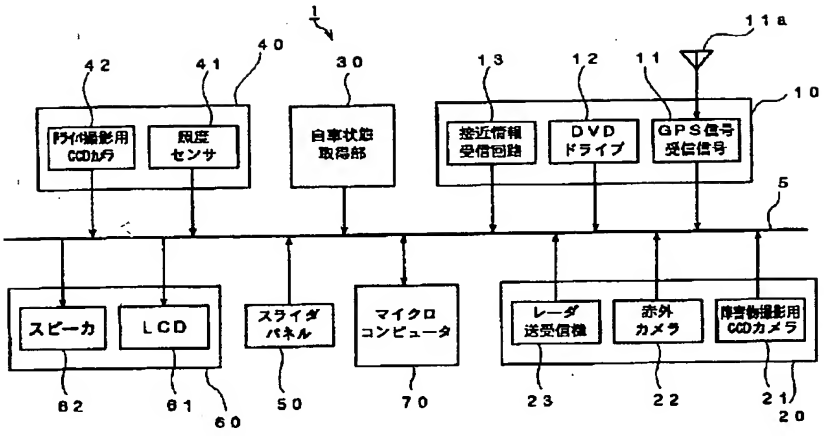
【図１７】



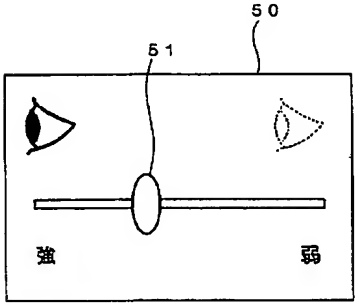
【図２９】



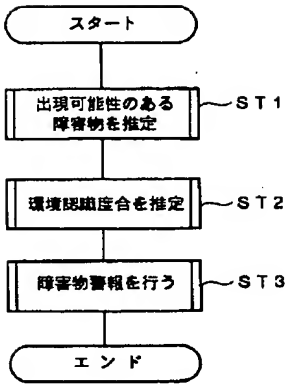
【図１】



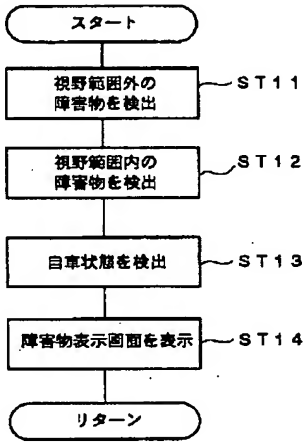
【図２】



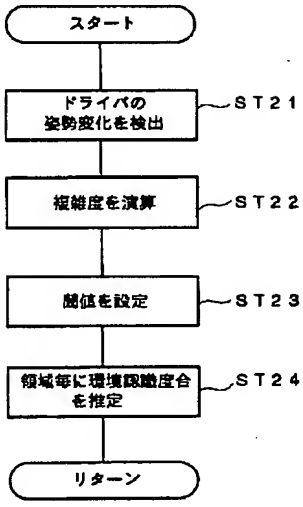
【図３】



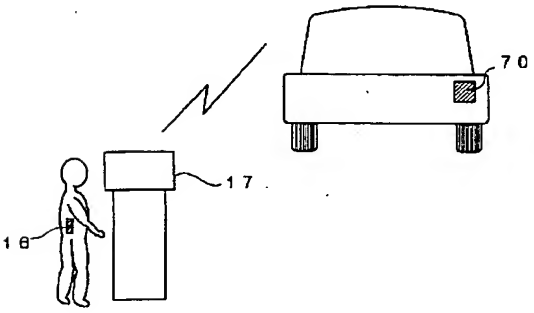
【図４】



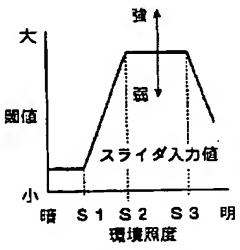
【図８】



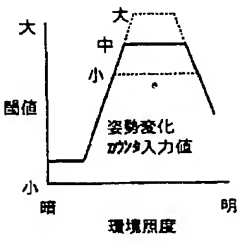
【図５】



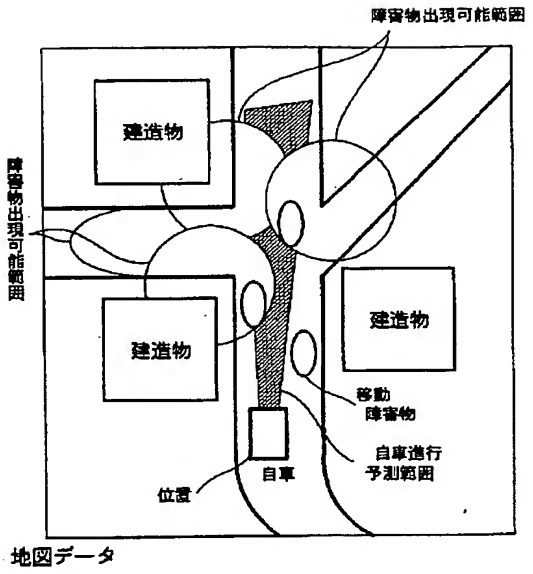
【図１５】



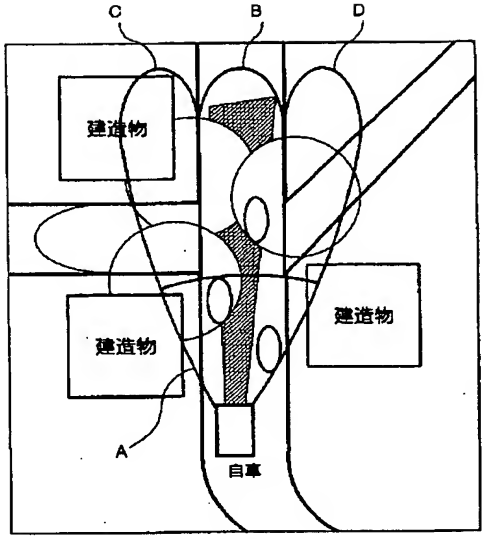
【図１６】



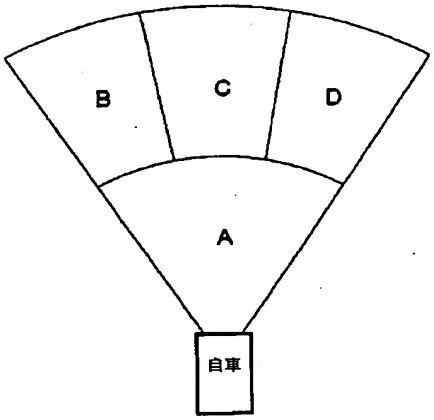
【図７】



【図９】



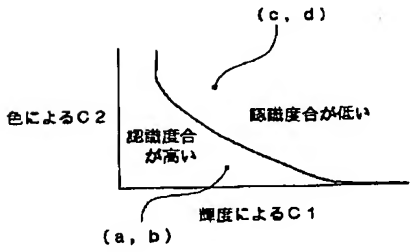
【図１０】

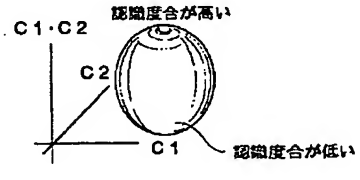


【図２８】

【図１１】

【図３０】





【図１２】

(A)

BK1

000	012	015	020	025	035	085	100
001	020	020	025	020	059	080	150
021	025	026	020	050	100	126	180
018	020	018	016	025	085	099	125
035	045	035	020	016	036	085	120
045	070	020	025	021	020	020	025
021	056	026	018	021	025	026	020
018	035	018	016	018	020	018	016

(B)

BK2 BK3

025	035	085	100
020	059	080	150
050	100	126	180
025	085	099	125

BK4 BK5

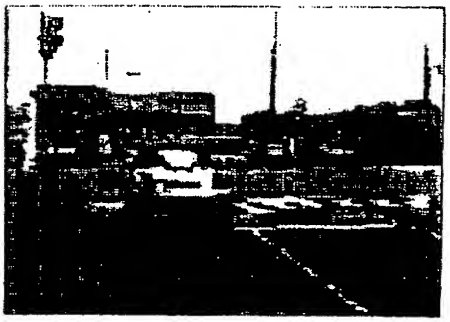
(C)

BK2

025	035	085	100
020	059	080	150
050	100	126	180
025	085	099	125

【図１３】

(A)



(B)

(C)

(D)

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1	1	0	1	0	0	0	0
1	1	1	1	0	0	0	0
0	1	1	0	1	0	0	0

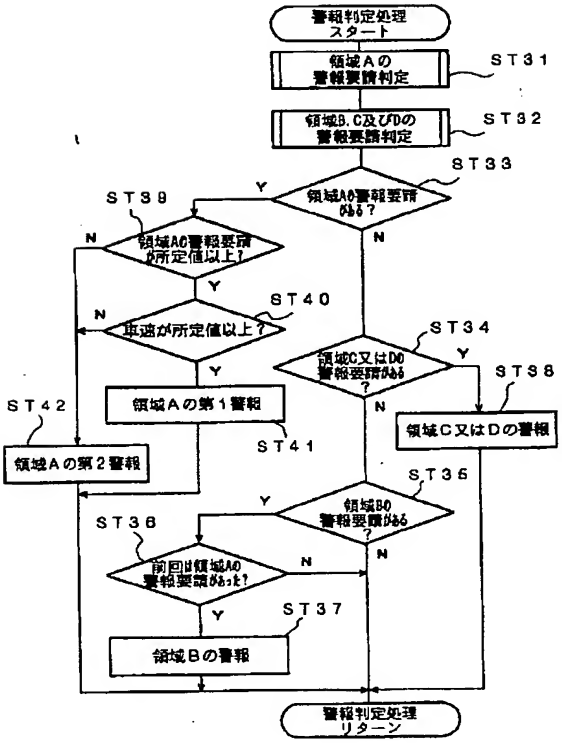
【図１８】

単純な前方風景例

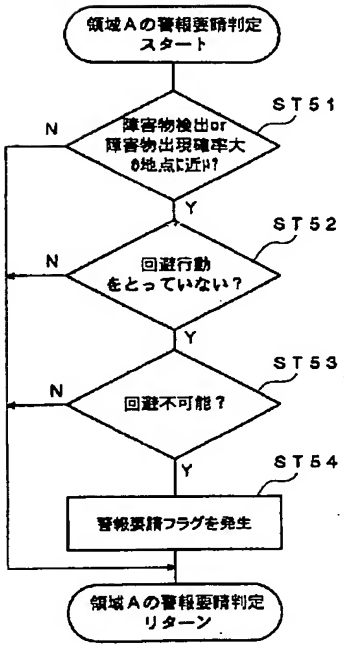
【図１９】

複雑な前方風景例

【図２０】



【図２１】



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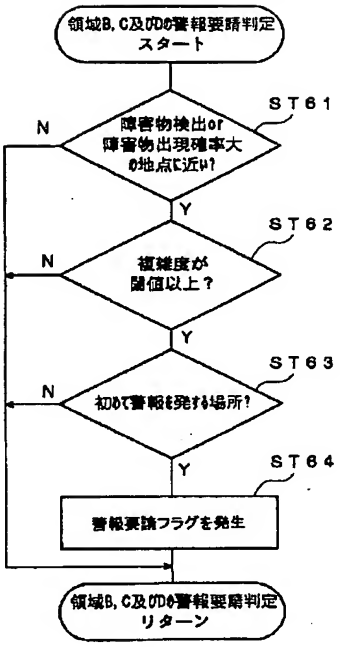
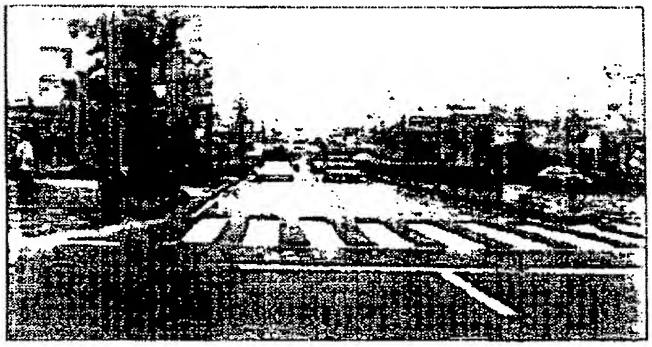
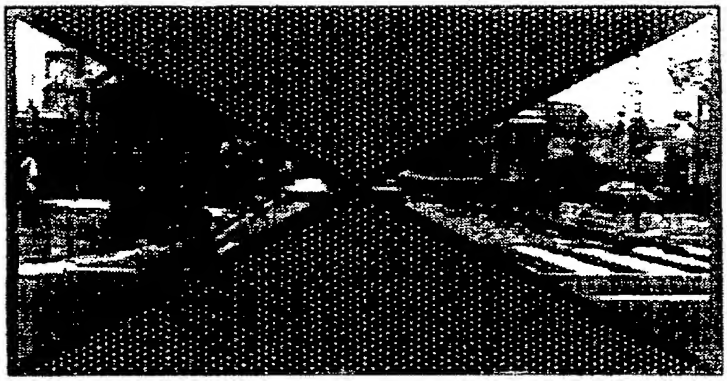


【図２３】

(A)



(B)



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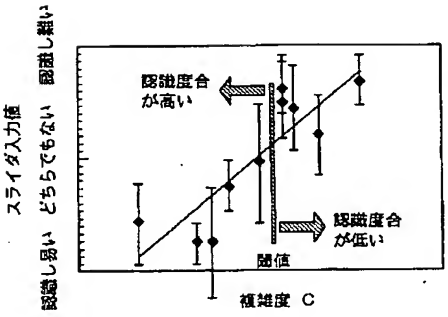
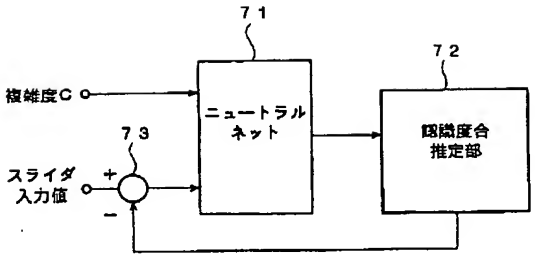


【図３１】



【図２４】

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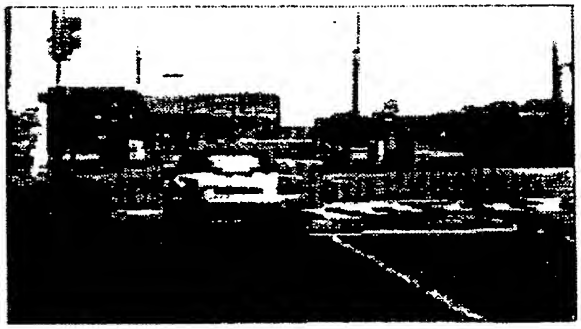

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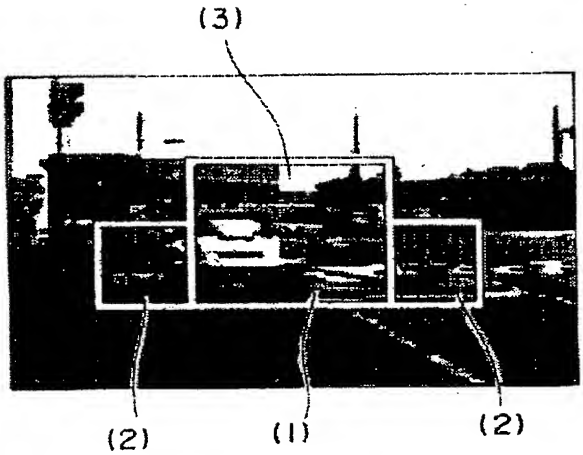
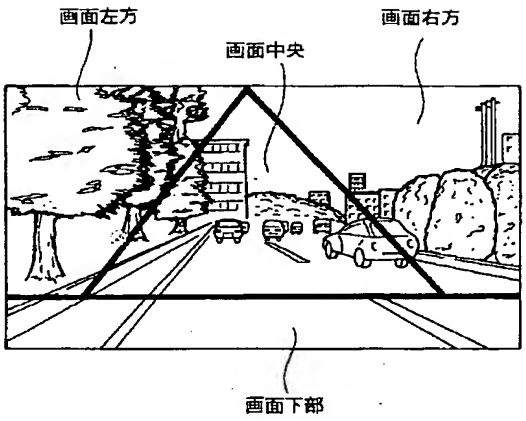
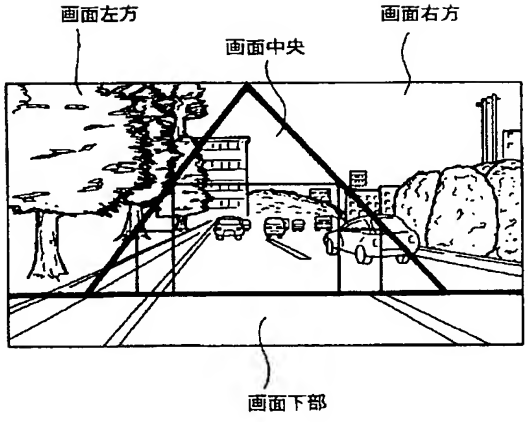


(C)

【図２５】



【図２６】



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	7/20	３００

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